Vol. 18 APRIL, 1925 No. 4

QUARTERLY

OF THE

National Fire Protection Association

Entered as second-class matter May 1, 1911, at the Post Office at Boston, Mass., under act of July 16th, 1894.

40 CENTRAL STREET, BOSTON, MASS.

National Fire Protection Association

INTERNATIONAL.

Executive Office, 40 Central Street, Boston, Mass., U. S. A.

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Underwriters' Association of the Middle Department.
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Western Canada Fire Underwriters' Association
Western Factory Insurance Association.
Western Insurance Bureau.
Western Sprinkled Risk Association.
West Virginia Fire Underwriters' Association.
West Virginia Inspection Bureau.
Wisconsin Inspection Bureau.

PRINTED IN U. S. A.

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Reports of fires appearing in the Quarterly are copies of or extracts from written reports forwarded to the Association. This Association, as a body, is not responsible for the statements or opinions of any of its members.

Photograph by Canadian Fire Underwriters' Association.

Montreal fire fighters had to handle three separate fires occurring almost simultaneously in the "inner conflagration district" of the city on night of January 28, 1925, with the temperature ten below zero. **(See report on page 395.)**

The Quarterly

Vol. 18 April, 1925 No. 4

The Twenty-ninth Annual Meeting. The twenty-ninth annual meeting of the Association, scheduled for May 12, 13, 14, in Chicago, will be held at the Congress Hotel. We were very comfortable two years ago at the Drake Hotel on Lake Shore Drive, north side, in spite of Chicago's delightful spring weather which manifested itself in a howling snow storm, and there is no doubt of the distinct value of a quiet location out of the roar of the city. However, there is a considerable group of our members who like to be down town and the Program Committee selected the Congress this year because of its admirable meeting room and commodious and convenient ante-rooms. Almost everybody in down-town Chicago has his face streaked with soot, but there is generally so cordial a grin under it, that visitors accept the dirt as a manifestation of Chicago's hospitality. We shall pay our usual visit to the Laboratories this year, and are advised that President Dana Pierce is planning a very interesting program.

* * * * *

***The Country Gentleman*, Incendiary.** The vast welter of print and pictures from the ever turning wheels of American printing presses probably gives a true cross section of the temper of the American people. Like the people as a whole it includes the good and the bad, the careful and the incendiary, conscious and unconscious. This rising tide of printed matter threatens sometimes to engulf us, but we somehow manage to keep afloat, doing what we can to stimulate the good, the publicity that spreads fire prevention information, and to stop, when it comes within our reach, the incendiary propaganda that unconscious editors broadcast.

In this effort we usually find editors glad to cooperate. It is somewhat of a shock to find the editor of such an interesting periodical as *The Country Gentleman* so difficult to impress.

The February 28th issue of *The Country Gentleman* had a cover design showing a boy kindling a kitchen fire, using kerosene. Mr. Frank Eldridge, Topeka, Kansas, representative of Marsh and McLennan (member N. F. P. A.) received his copy of *The Country Gentleman* in the same mail with a newspaper containing the all too familiar story, "Man Burns to Death; Was Pouring Oil in Stove—Explosion Occurred." Mr. Eldridge wrote the N. F. P. A. Executive Office as follows:

> In justice to thousands and thousands of people ignorant of the fire hazards involved in the use of kerosene for starting fires, should not *The Country Gentleman* be asked to publish the sequel to the enclosed picture? Evidently the young man intends to use a little kerosene to hurry matters along and probably with the result described in the clipping attached; both received in my home the same day.
>
> The picture was intended to cause a smile, but to one knowing the hazard a shudder comes and he can see only the gruesome specter of death.
>
> This boy, probably the oldest of a large family of children who with the parents are all still asleep in the house, has never been told of what might happen. The broken plaster on the wall would indicate that the family could ill afford the impending catastrophe. In a moment the lad will pour the explosive liquid on the feeble flame. We see him suddenly enveloped in flames. The room is ablaze and fire spreads rapidly to adjoining rooms. The boy dashes wildly to the other rooms breathing flames as he cries for help. The parents rush down to aid the burning boy. The whole house is filled with smoke and flames. Upstairs, asleep, are the other children, asleep, possibly never to wake again. This may be a small village with only a bucket brigade for fire fighting and the home is now in ruins. A family wiped out. WHY? IGNORANCE.

We wrote the editor, sending him a copy of this letter, the original newspaper clipping, and our own comments:

> The harm done by a picture such as that appearing on the cover of *The Country Gentleman* cannot be amended by any subsequently published correction. The lives that may be lost through the using of kerosene on fires as a result of the implied recommendation of this picture cannot be restored. Only a fraction of those who saw the original picture will read any subsequently published warning, but it is not too late to publish a correction which will be of value. We sincerely hope that you will plan to do this at the earliest opportunity.

The reply of *The Country Gentleman,* signed by E. Dinsmore, art editor:

> Thank you very much for your letter of March 3rd. It is always a pleasure to hear from our readers and to receive their comments and criticisms on the contents of *The Country Gentleman.* Naturally we had no idea of running anything but what seemed to us a very amusing cover and we can only hope that to most of our readers it was just that.

The selection of this cover picture by the art editor of *The Country Gentleman* was undoubtedly influenced by the notion that a half-dressed

boy shiveringly lighting a fire on a frosty morning by pouring kerosene on a kitchen fire is a sufficiently common practice in country houses to be recognized by the readers of this periodical as typical. We can testify that it is, and the vouchers for this testimony are the press clippings that burden our mail chronicling the daily deaths of women and children, and an occasional man, from this practice. Possibly a short subscription for clippings on this topic might leave the art editor less cheerfully complacent, or perhaps divert his humorous researches into some such an amusing cover picture as a boy shooting an apple off his little sister's head with a shot gun. This used to be quite common in the country and had the advantage of killing but one child at a time. The practice that Mr. Dinsmore found amusing for purposes of illustration usually takes a toll of three or four.

* * * * *

A Nigger in the Woodpile. All sorts of tricks and subterfuges are resorted to by persons who desire to evade the restrictions of building codes, and where a code is made up locally it is apt to include some "joker" injected by sly persons seeking personal privileges. Seldom, however, is one of them helped by such a silly phrase as enabled some builders in Shreveport, La., last month to reduce the required distance between wooden buildings. This portion of the city building code which regulates the proximity of frame dwellings was held invalid by a local judge in an opinion handed down in the injunction suit to restrain the city building inspector from interfering with the erection of a frame apartment house. The court held that the section of the code was invalid because it was discriminatory in that it required that all frame buildings shall be built eight feet apart, but added "that this shall not apply to negro houses." While the property involved was not negro property the court held that the city was without right to classify buildings according to race or ownership.

It might have occurred to the judge that the provision should apply to buildings housing colored people also; but that phase of the matter was not at this time before the court.

* * * * *

Kansas City on Her Knees. Standing in Kansas City's "Royal" Auditorium and contemplating the $1,000,000 wreck of her auto-show, one had a bewildering feeling of futility. This "fireproof" building with wooden roof on unprotected iron supports, and 150,000 feet of lumber in it to provide balconies and booths, burned like a cardboard box. Two hours before the fire it had been packed with people, relying upon only two exits for egress, and these most of the

crowd had to search for in order to get out. Kansas City is burning, steadily and progressively most of the time, neither the building department nor the fire department offering much objection. The story of the auto-show fire as written by our member, the Missouri Inspection Bureau, needs no expert to discover the cause of this stupendous and preventable loss. In visiting Kansas City at the time of this fire the Secretary of the N. F. P. A. encountered his friend, State Agent Shipe of the New Hampshire Fire Insurance Company, with a letter in his hand and a look on his face expressing nothing at all, very forcibly. The letter was from the home office and was a reply to a request made by Mr. Shipe for permission to buy a new office rug. Secretary Frank E. Martin, the literary member of the official family of the New Hampshire, was Mr. Shipe's correspondent. The letter was as follows:

New Hampshire Fire Insurance Company
Manchester, N. H.

February 20, 1925.

W. G. Shipe, State Agent,
Kansas City, Mo.

Dear Sir:

We have your esteemed favor of February 17 relative to purchasing a rug for your office.

We have no objection and your suggestion is approved. In view of the past losses, we suggest that you *buy a prayer rug.*

Yours very truly,

F. E. MARTIN,
Secretary.

If anything could be added to the dramatic value of the terse and cryptic utterance of Mr. Martin it might be that a few other people in Kansas City might do a little praying beside Mr. Shipe.

* * * * *

The Telephone Exchange Fire. The telephone is now such an integral part of our everyday life that we scarcely realize the extent of our dependence upon it until the service is interrupted by some accident such as the fire in the Boston main telephone exchange, shown by the picture on page 320. The maintenance of continuous telephone service is such an important public responsibility that it seems obvious every possible precaution should be taken to prevent its interruption by fire. Yet the Boston exchange fire is conclusive evidence that conditions favorable to fire had been permitted and that the wires providing toll service for the entire metropolitan district were all exposed to a single fire. To those who believe that every fire loss is preventable, either by preventing ignition itself, or by such construction, subdivision and pro-

tection that the effects of fire will be slight, the following screed broadcast by the publicity department of the telephone company is rather amusing:

Fire!

Swarming like bees over the frames, one relief after another, night and day, our men have done the work of two months in four days and restored the toll telephone service of New England.

It was Monday evening, February 16, that fire struck a wicked blow at the chief nerve-center of New England's telephone system,—Boston Toll, the second largest toll center in the world. It destroyed the test-board through which 50,000 inward and outward toll calls pass daily, melted 1400 toll circuits and 600 local trunk circuits into copper junk, and paralyzed communication between Metropolitan Boston and the rest of the territory we serve.

By happy chance, a new $600,000 toll-test-board, under construction for more than a year, was scheduled for duty April 15. Into this board the wrecked lines were cut in desperate haste,—husky cable-men, installers, maintenance-men, repair-men, giving their best. More than one white-collar engineer, risen from the ranks, donned overalls and jumper and took his old place in the crews.

To our friends who were inconvenienced in their business and social relations, we express our sincere regret. But the job is done. We are ready to serve.

The telephone company deserves congratulation on their prompt restoration of service, but what a picture the publicity department gives us! White collar engineers swarming like bees doing two months' work in four days, and the naive admission that only the happy chance of available new equipment prevented much longer delay! Under the circumstances one could hardly expect the company to admit that the wicked blow might have been prevented, or its severity at least greatly minimized by subdividing the number of circuits exposed in a single fire area.

* * * * *

Stronger Oil Tanks? From the new oil fields come stories of the rush to provide storage capacity for flush production, of how no sooner is the bottom ring of steel tank plates erected than oil is pumped in, erection of higher rings keeping pace with the pumping. This is doubtless an exaggeration, but is indicative of the haste prevailing in some of the newly developed oil fields. Proper tank construction, fire-safe tank construction, cannot be expected under such conditions. Fortunately experience has not indicated that any considerable proportion of oil tankage has been erected in any such slap dash manner.

It is said that under average conditions oil tank building competition is largely on a price basis, with little emphasis on quality, a condition not conducive to the best engineering practice. Even under the best conditions, however, there is some doubt as to whether present practices in oil

tank design give an adequate margin of safety.

On another page of this QUARTERLY is described the failure of an oil tank in Oklahoma, with ensuing fire that destroyed two tanks. These tanks were apparently properly constructed and seem to just meet the N. F. P. A. specifications for thickness of material in the bottom ring where the initial crack occurred. An analysis of the conditions obtaining at the time of this accident shows a plausible theory to account for this failure, somewhat as follows:

At the time of the break there had been a sudden drop in temperature with the result that there was approximately sixty degrees difference in temperature between the oil in the tank and the outside atmosphere. The steel plates comprising the bottom of the tank, not being exposed to the outside air, remained at a temperature of approximately 60° F. The outside shell of the tank, especially at the bottom where there was probably heavy sediment retarding convection currents of oil that would otherwise tend to equalize the temperature, was nearly at the temperature of the outside air, four degrees below zero. This sudden cooling of the lower ring of the tank shell resulted in contraction, pressing against the edges of the bottom plates. The stresses resulting were the same as if the bottom had expanded, exerting pressure against the shell. Still further tension in the bottom plates of the tank shell may have been caused by unequal settlement of the ground supporting the tank or by initial stresses set up during the welding of the bottom. These stresses were in addition to the pressure of the oil in the tank. The cumulative effect of the oil pressure and these temperature and other stresses opened a crack at a weak point in the shell which at best only had a factor of safety of 2½, making no allowances for any stresses except those due to the pressure of the oil. That the crack occurred away from the riveted joint is perhaps not surprising in view of the fact that the type of joint used had an efficiency of probably nearly 90%. Once a crack opened, the ignition of the escaping oil and the ensuing damage is not hard to explain.

Whether or not this theory is correct the fact remains that the tank did fail, that the design did not provide strength to withstand the unusual stresses responsible for the failure. In bridges, in buildings, in most of the everyday engineering uses of structural steel, in addition to making allowance for extra stresses such as those due to wind or extreme temperature changes, the common practice is to use a factor of safety of at least 3 and often 4 or higher. The consequences of failure, the collapse of buildings, the falling of bridges, are too serious to permit taking chances by not providing an ample safety margin. Why should not oil tanks be similarly treated? Perhaps the answer is that tank failures, like that in Oklahoma, have not been frequent. But the possible consequences

of the failure of oil tanks in or near our larger cities are such that this subject deserves more careful consideration than it seems to have received in the past.

* * * * *

Drastic Legislation Defeats Its Purpose.

The fire in the Scobey private hospital, Boston, reported elsewhere in this issue, is interesting as a fire but perhaps more so in the light that it throws on the kind of legislation which is usually proposed after such a tragedy, with the object of preventing another.

Following the fire, Mayor Curley announced that he had instructed the health and building commissioners not to issue the annual permits for hospitals this month unless the buildings have sprinklers and automatic fire alarms. Because of practical difficulties, how extensively this will be done remains to be seen.

Mayor Curley, in addition, announces that he will seek to have the fire alarm boxes of the city system brought up to date, and goes on to state:

> "We have prepared a very ambitious program of fire protection, which we trust will be enacted into law by the Legislature of the Commonwealth.
>
> "This program provides that all buildings at present in use or that may hereafter be constructed, used as places of habitation, and more than three stories in height; all buildings used as places of public assemblance, including halls and theatres; all private hospitals and public and private schools; shall be equipped *throughout* with a system of sprinklers and *automatic fire alarms.*"

In evident accord with the Mayor's campaign numerous bills have found their way into the state legislature,—all to be rejected. Each bill, seemingly framed in a moment of hysteria, has been so drastic that rejection might have been reasonably anticipated. There seems to have been little or no regard for whether or not the proposed bills had any chances of being passed or enforced. Senate Bill No. 171, for instance, calls for the installation of automatic sprinklers *throughout* in tenement houses or buildings used as hospitals, making no allowance for the character of the construction of the building. House Bill No. 256 proposed the requirement that all hospitals be built of "fireproof" construction and be, in addition, equipped with automatic sprinklers *throughout*. A similar act was proposed requiring places of public assembly to be sprinklered *throughout*.

Thus for all their good intentions, the proposers of ill-considered legislation defeat their own purpose. Hospital directors opposed these pieces of legislation and were successful in having them withdrawn because of their very severity. The medical profession has not yet acquired the knowledge of or confidence in automatic sprinklers that fire protection engineers have. The good doctors have an unreasoning fear of a sprinkler

head opening unexpectedly over a patient's bed, in spite of the remoteness of such a possibility in a properly maintained system such as a hospital could certainly provide. They do not see the possibility of injury to the patient and others by the fire or panic which sprinklers, by confining the fire to one room, would prevent. Until the doctors can be convinced, however, their judgment is likely to be followed. It should also be considered that the funds necessary to put in a complete sprinkler system are not always available to a hospital, and in this situation we must be satisfied if they are required in the most dangerous portions such as the basements, kitchens, stairways, and attics.

While we may not perhaps be ready to insist on sprinklers throughout in fire-resistive buildings, still it is evident from this fire that every part of a non-fire-resistive hospital building should be equipped with sprinklers, and especially that the horizontal and vertical openings of such structures should be properly protected. Here the one loss of life would undoubtedly have been prevented had a standard automatic fire door been used to cut off the section of the hospital in which the fire started from the rest of the building. In view of the rapidity with which this fire spread, the construction of the building and the helplessness of most of the patients, it is remarkable that the loss of life was no greater.

The Insurance Agent and Fire Prevention.

By James T. Catlin, Jr.

(Member N. F. P. A.)

Former President Virginia Association of Insurance Agents.

If there ever was a test of loyalty for the insurance agent, it can be found in his fire prevention activities. Every agent who gives up his time, money and services to the reduction of fire losses is rendering a distinct service to the insuring public and, after all, service is what the agent's business is built upon. The majority of them deliver the same contract at the same rates, but the most successful is the one who renders real service with his contract of indemnity.

As I see it, the agent lends his activities in fire prevention work without the hope of receiving any possible benefits. If through his efforts fire losses are reduced over a given period and rates are not reduced as in all probability they should be, then the companies receive the benefit. On the other hand, if the rates are reduced, then the assured receives the benefit, and the agent's lose on account of reduced commission. This is a distinct service, however, that he owes to the insuring public which, unfortunately, is not recognized by the vast majority of agents doing business in the country today.

Meeting of Executive Committee.

January 17, 1925.

The midwinter meeting of the executives was held on the above date in Atlantic City, the following members being present:—

A. T. Bell, Atlantic City, Chairman.
George W. Booth, New York.
George W. Elliott, Philadelphia.
Samuel D. McComb, New York.
William F. Steffens, New York.
H. V. Thayer, Boston.
Louis Wiederhold, Jr., Philadelphia.
Rudolph P. Miller, New York, President.
Allen M. Schoen, Atlanta, Vice-President.
Franklin H. Wentworth, Boston, Secretary-Treasurer.

R. S. Moulton, Assistant Secretary, and Percy Bugbee, Field Secretary, were present by invitation.

The Association's field service was reviewed and methods of financing it left to the Finance Committee for consideration in the light of the discussion by the Executives.

The plan for the employment of an electrical field secretary to promote the uniform application and observance of the National Electrical Code was approved, the project to be financed by a group of members having representation upon the Electrical Committee.

Following vote of annual meeting 1924, that consideration be given to the matter of increasing the amount of membership dues not to exceed 25%, this matter was discussed and no action recommended.

In view of urgent letters from chairmen of technical committees, the regulation limiting the duration of chairmanships and prescribing the retirement of 20% of committee members annually was suspended.

The idea of the establishment of sections in the N. F. P. A. for group promotion of the fire prevention work of special classes of members was favorably discussed and referred to the officers for consideration.

A resolution was adopted in commemoration of the valuable and devoted service to the Association of the following former officers and members who have passed away since the last meeting of the committee:

Uberto C. Crosby, Boston, Past President.
F. J. T. Stewart, New York, Past President.
Walter F. Ballinger, Philadelphia, Committee on Building Construction.
Hubert S. Wynkoop, New York, Electrical and Marine Committees.

The Secretary was requested to communicate the fact of this resolution to the families of the deceased members.

The work of the American and Canadian Joint Fire Prevention Committees in which the N. F. P. A. is co-operating in the United States with the American Water Works Association, and the International Association of Fire Engineers, and in Canada with the American Water Works Association, the Canadian Manufacturers' Association and the Dominion Association of Fire Chiefs (all members N. F. P. A.), was discussed and commended.

It was voted to adopt the recommendations of the Committee on Piers and Wharves for changes in the Regulations on Piers and Wharves, with respect to items referred to the committee by the 1924 annual meeting (Proceedings 1924 pages 129-158). The sections revised are as follows:

206. Add:—Note. These unusually large areas are accepted on the basis of standard automatic sprinkler protection.

814. First aid fire appliances shall be provided as specified in sections 815 to 821 inclusive, except where modifications are required to meet special conditions. These shall be installed and maintained in accordance with the Regulations for the Installation, Maintenance and Use of First Aid Fire Appliances.

823. Watch Service. Approved watch service shall be provided on each pier or wharf with strong, efficient, able-bodied men on duty at all times, reporting on approved recording devices, as follows:

(*a*) In locations where available central station service shall be installed.

(*b*) In locations where central station service is not available a stationary or portable clock shall be installed.

Watchmen should be supervised and carefully instructed in regard to summoning aid, maintenance and use of fire appliances, inspection of hazards and closing of fire doors.

In addition to the above several editorial changes were approved, including the insertion of revised loss figures in section 4, referring to the fire record.

A communication inviting the N. F. P. A. to membership in the American Marine Engineering Standards Committee was referred to the Chairman of the Marine Committee N. F. P. A. for consideration and report back with recommendations to the Executives.

Mr. Albert W. Pell (president of former New York Chapter N. F. P. A.) was requested to appoint, in conference with President Rudolph P. Miller, a local committee of New York members to act for the N. F. P. A. during the year 1925 in matters affecting fire hazards in New York City.

The resignation of William Emerson from the Executive Committee was regretfully accepted.

The appointment of President Rudolph P. Miller as representative of the Association to the American Construction Council was confirmed.

The appointment of H. E. Newell, Chairman of the Committee on Gases, as the N. F. P. A. representative upon the sectional committees

of the American Engineering Standards Committee having charge of the projects of a Gas Safety Code and a Mechanical Refrigeration Safety Code, was confirmed.

The following Committee appointments made by the officers subsequent to the last meeting were confirmed:—

Automatic Sprinklers:	F. J. McFadden, New York; R. L. Rumbaugh, Chicago.
Field Practice:	A. O. Boniface, Utica; Clarence Goldsmith, Chicago.
Flammable Liquids:	William B. White, New York.
Signaling Systems:	C. C. Johnson, New York.

Not the Cat's Fault.

No, the pussy hasn't anything to do with it, as the *Fireman's Fund Record,* the contributor of this photograph, says about the picture. It is definite evidence against this frequently occurring hazard. Usually, when this happens, the evidence destroys itself.

The electric iron was left connected for seven hours while the family was away. If it had been on something other than the comparatively slow burning ice box the story might have been different.

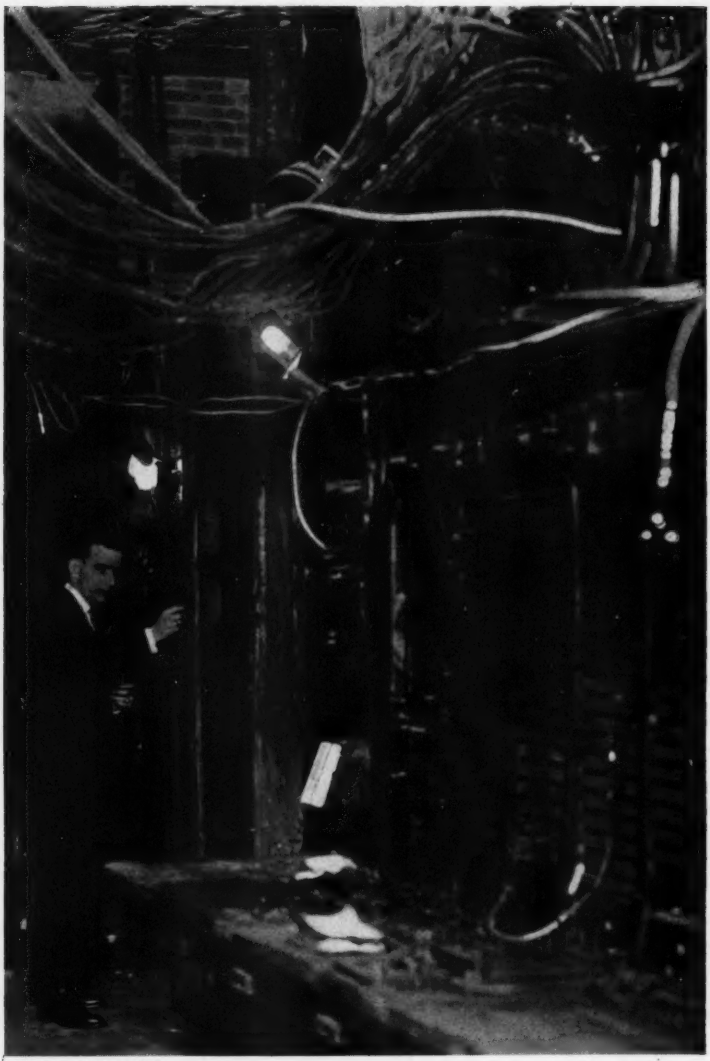


Photo by Boston Globe.

The "toll test board" of the Boston main telephone exchange after the fire of February 16. This fire, occurring in a small room on the roof, disrupted toll service throughout Metropolitan Boston and caused a direct fire loss estimated at $125,000 besides large indirect losses due to the interruption of service.

The Story of Fresno.

A Tale of the Redemption of a Fire Department.

Fresno is a pleasant city of California reposing in the fertile San Joaquin Valley. As a fruit raising district this valley has few equals and when irrigation plans were developed Fresno began to grow. The valley trade centralized here and warehousing and packing plants multiplied. In 1900 the population was 12,000; in 1920 it was 45,000, and it now approaches 90,000. Fresno's industrial output in the census year of 1919 was valued at $48,944,000. Naturally Fresno has had things to burn and up to 1923 was burning them, quite regardless. Here are the figures:

	Total Loss	*Loss per capita*	*Fire Alarms*
1918	$514,747	$10.72	294
1919	781,938	15.64	459
1920	505,292	10.10	363
1921	1,840,562	33.46	485
1922	558,947	10.54	450
1923	187,565	2.21	279
1924	259,823	2.98	250

The year 1924 would have made an improved showing were it not for one fire of $138,000, starting in a packing plant the hazards of which were well known and respecting which court action was contemplated.

While several American cities have indefensible fire records, Fresno led them all in average delinquency for the first five years recorded in the above table. Fresno is not without some excuse. When a city grows with such rapidity land values are not yet stabilized and so builders are generally timid and building construction is poor. Given this basic condition; add to it public indifference and poor housekeeping, and destructive fires are the logical result. The underwriters stood the terrific strain of these conflagration years, all of them losing money, until it was obviously imperative that Fresno's reckless burnings must be challenged. When 1920 contributed its sorry figures the insurance rate of the city was increased 25%. This produced the reactions that invariably follow a shock to the pocket nerve. There was political "yapping" and considerable business discontent. The influential citizens, however, had the sense to see that Fresno was bleeding her sister cities white and that she deserved the twenty-five per cent infliction. A dozen of them got together for a confidential discussion of the matter and wondered who could tell them what to do.

In San Francisco there was Jay Stevens, one time assistant chief of the Portland, Oregon, fire department, now chief of fire prevention on the Pacific Coast for the National Board of Fire Underwriters. Mr. Stevens is also state fire marshal of California, Secretary of the Pacific Coast Association of Fire Chiefs, and Vice-Chairman of the Committee on Fire Department Cooperation of the National Fire Protection Association. The only reason he hasn't a lot of other offices is because there are only twenty-four hours in his working day. Some time before this Mr. Stevens had spoken before the Lions Club and several Fresno people had got the notion that he had said something. The citizens' committee sent for him to come to Fresno to a meeting on a certain night when every man was pledged to be present. Mr. Stevens was detained beyond train time in San Francisco but telephoned that he would come by motor if they would wait for him until nine o'clock. "We shall be waiting for you if it is midnight," they said. They waited until one o'clock but Mr. Stevens did not appear. He was lying unconscious beside the San Francisco highway under his overturned automobile. For over a year his courageous spirit contended with his torn flesh and broken bones. He finally left the hospital and limped back to his office. The nurses had told him that in his delirium he was hurrying to Fresno and he replied that he'd get there yet.

The Fresno citizens were not idle. They conferred with the water company and secured extended and better service; they stimulated the new city commissioners to get more fire apparatus and houses to install it, to build a drill tower, and to create an inspection bureau in the fire department; but the bad losses continued. Something was the matter. As is always the case where fires from carelessness are frequent many were deliberately set. The Commissioners picked a good man from the fire department, Captain Ralph Williams, and made him fire marshal. Captain Williams' energy not only put fear into the hearts of the fire bugs, but expressed itself in fire prevention activities, educational and other. But the fires kept burning. It was October, 1922, a year and a half since the night the citizens sat waiting for Mr. Stevens, and in that year and a half the losses had aggregated $2,000,000. In the light of subsequent events it seems as if that was what Mr. Stevens' auto wreck cost Fresno. Captain Williams staged a fire prevention campaign in October, 1922, and solicited Mr. Stevens' help. Mr. Stevens responded. He had been quietly studying Fresno and thought he knew what the trouble was. He made a speech at the luncheon of the Rotary Club and declared the citizens had done all they could; that the fault lay not with them but with the fire department; that the fire department was a rotten stick on which the city could not safely lean. The chief of the fire department was at the luncheon.

It is the habit of cities to idealize their fire chiefs, and because of this the acts of these public servants often escape the scrutiny that might reveal their shortcomings. Because the American people have not yet recognized the supreme importance of this office they have not demanded in it the degree of intelligence and ability they should demand. Mr. Stevens' experience had taught him what an efficient fire department was. His declaration set Fresno buzzing. The mayor was out of town but returned post-haste, called a conference of his officials, and sent for Mr. Stevens. The mayor informed him that he had heard of his talks before the clubs and that he had been quoted in the press as saying the Fresno fire department was in a rotten condition. He wanted to know if these were facts. Mr. Stevens replied that they were. The mayor asked him if he had actually made the statement that the fire department was rotten. "Yes," Mr. Stevens replied. "Do you think the fire department is as bad as that?" asked the mayor. "Worse!" replied Mr. Stevens. "I cannot find words to describe the actual conditions." The mayor asked why Mr. Stevens had not told him about the conditions. Mr. Stevens replied it was because he was not in the city. "There were others you could have gone to in my absence," said the mayor. Mr. Stevens stated he had gone to others in his absence. "To whom?" His Honor inquired. "To the chairman of the fire commission," replied Mr. Stevens. The mayor turned to the chairman and asked him if Mr. Stevens had talked with him and told him the things he was quoted in the newspapers as saying. "Yes, sir," replied the chairman, "and much more." "Have you talked to any other members of the fire commission?" asked the mayor. "To one other, who is present," replied Mr. Stevens.

The mayor asked the commissioners how they felt about these statements and one arose and said it was hard to believe the fire department was in the terrible condition the speaker had maintained. Turning then to Mr. Stevens the mayor said, "Chief Stevens, we all feel pretty much the same way here. We have been doing a lot of work in connection with our fire department, spending money improving it. We have confidence in our fire department; we think it is all right. We don't feel as you do about our fire department being rotten, and we demand that you either prove your statements or move on—get out of town." Mr. Stevens stated that he expected to be asked to prove his statements, had made them with that thought in mind, and was ready to start in. "When?" asked the mayor. "Will tomorrow morning be too soon?" asked Mr. Stevens. The mayor: "No!" Mr. Stevens: "Where?" The mayor: "Here in my office."

On being asked who should be present, Mr. Stevens left it to the mayor, merely advising that the press and public should be excluded,

leaving the mayor free to give out such information as he chose after the meeting. "You have witnesses?" asked the mayor. "Yes," said Mr. Stevens. "I shall call them in the morning."

The investigation, at which were present the mayor, city commissioners, fire commissioners and a court reporter, began at 9 o'clock the following morning and continued until 12:30 midnight. It was adjourned until 8:30 the second morning and closed at 11 o'clock that night. The tale is an absorbing one; one of human delinquency, insubordination, incompetence, and bewildering disorganization, dramatic and disconcerting; too personal in character to relate without injustice to some who were caught in it without being wholly culpable. At the close of the meeting one of the commissioners arose, stating he had something to say.

"Mr. Mayor," he said, "I am in a little different position from the rest of you. I didn't know this gentleman before meeting him in your office the day before yesterday. I did not hear him talk on his previous visits; so when I read in the morning papers that he was making derogatory statements about our fire department I was very much displeased and said to myself, 'He is just another attempting to throw dust in our eyes and justify our high insurance rates,' and I certainly was in sympathy with you when you told him here at the meeting that he must prove his statements or get out. At this time I want to apologize to Mr. Stevens for having such thoughts, for if ever a man has proven his statements, he has, and personally I am in favor of a new regime in the fire department from the head down. I am ready to vote for the appointment of any man that Mr. Stevens will name to head this department and straighten it out. I will vote for a Chinaman if he proposes one."

Mr. Stevens arose and said, "Gentlemen, I feel I have finished my labors here. If I have proven to your satisfaction that conditions are as I stated I am ready to take the midnight train for San Francisco. I have much other work to do."

"No," said the mayor. "You have not finished here yet. It is now up to you to assist us in getting a new chief and in the reorganization of our fire department, which you have demonstrated to my complete satisfaction is absolutely necessary."

It had been made clear that the bad conditions in the fire department were due to lack of discipline, general insubordination, and incompetence of the officers. The chief pleaded for another chance, saying that he knew conditions were bad but not as bad as Mr. Stevens' investigation had revealed.

Mr. Stevens: Why didn't you know of these conditions which I have exposed?

The chief: Because I didn't have the opportunity of finding them

out that you have had. You have a different method of going about it.

Mr. Stevens stated that the chief had been there for many years, whereas he had been there only a few days.

The mayor asked Mr. Stevens if he thought the chief ought to be given another chance, but the latter replied very emphatically that he was opposed to the chief being given another opportunity; that he had had several opportunities. Mr. Stevens asked the chief if he had not been called before Mayor Hart at the time of the mayor's taking office two years previous and told that he must straighten out the department and put it on an efficient basis. He replied that he had been called before the mayor. Mr. Stevens then asked him why he had not carried out the mayor's orders. He replied because he did not know that the mayor meant what he said.

"What is that?" inquired the mayor.

The chief: That is right, mayor, I didn't know whether you meant it or not.

The mayor: You will find out now whether I meant it or not.

Mr. Stevens then asked the chief: "Suppose the mayor should decide to give you another chance and asked you to start in right now with your reorganization, just what would you do—what would be your first move in reorganizing the department?"

The chief: I would discharge every man who has been implicated in any way with the mis-handling of this department.

Mr. Stevens: That would remove 90% of your 140 men.

The chief: As many as that?

Mr. Stevens: Yes. How would you fight fires?

The chief: I couldn't with such a force.

Mr. Stevens: What then would you do?

The chief: I don't know.

After the chief left the room one of the commissioners asked Mr. Stevens, "Just what would *you* do?"

"Do nothing," replied Mr. Stevens, "so far as discharging the men is concerned. The men in most cases did trivial things for which they were not responsible due to the laxity of the officers. In the major offences the same thing is true, although some of them should be discharged. It is hard to say just which ones should. I believe that all of them below the rank of assistant chief should be given an opportunity to make good. The thing you need to do is to try them out under new influences."

Mr. Stevens' counsel was heeded by the commissioners. The first assistant chief was pensioned for disability resulting from injuries received in the line of duty. The second assistant chief was discharged. The chief was demoted to second assistant chief. The chief's sins had

been sins of omission, and for this reason the commissioners finally decided that he should hold office as assistant chief, as he would work well under the direction of a forceful and competent man.

A forceful and competent man was found in southern California. He was Thomas Baird, formerly first assistant chief at Fresno, who had removed to Los Angeles. He was asked to return to Fresno and tackle a man's job. He consented. His accomplishment in mere dollars and cents is recorded in the fire loss statistics for the years of 1923 and 1924 given above. "We can never," said Jay Stevens, in discussing recently the Fresno situation, "give too much credit to Chief Baird for his accomplishments in reorganizing the department, installing modern methods of fire fighting and fire drills, generally systematizing the work of the department and perfecting its fire prevention activities." Mr. Stevens said it would be impossible to find a man who could have done better than Chief Baird and it would be mighty hard to find his equal. Chief Baird had the imagination to see the value of an informed public opinion, and encouraged the perfecting of a non-political citizens' fire prevention committee to operate as his advisory cabinet through whom he might transmit to the people of Fresno a knowledge of the fire department problems which the people themselves might, by their cooperation, help him to solve. He declares that this committee has been, and yet is, of inestimable value to him. "The organization of such a group," says Fire Chief George L. Johnson of Waltham, Mass., "is no good for the political fire chief; but for the people's fire chief it is wonderful."

With the gentlemen of the city commission standing loyally behind him and the fire prevention committee ready at all times to make his policies publicly understood, Chief Baird successfully secured the cooperation of the people of Fresno in redeeming their city. The activities of the present fire department embody a program one generally expects to find only in the department of a very large city. The general upheaval which the complete reorganization of the fire department occasioned further stressed the importance of improving also the water distributing system, which has since been very markedly improved. The water company officials were called before the fire commission and in joint meeting the entire matter was gone over. It was admitted that the water situation in Fresno was not satisfactory, and while no legal action was considered desirable, or as a matter of fact, possible, the water company officials agreed to plan and carry out an extensive campaign for the improvement of the water situation locally and the officials of the water company have more than complied with the pledge made to the fire commission at the time of the meeting.

The complete details of the campaign to make Fresno fire safe cannot

be recited in the space allotted to this article. The first work undertaken by Chief Baird in the fire department was an attempt to analyze conditions and formulate a plan for readjustment which would insure a correction in all directions of the deplorable conditions which existed. The first actual move was to appoint a physical instructor and drill master. This man was given complete charge of the physical training and drilling of the department members, the drill school was reconstructed, reorganized and equipped so that it is now one of the best equipped drill schools in the West. The man who was appointed drill master, Captain J. M. Daugherty, was in due time sent to New York where he took the New York Fire Department College course in the spring of 1923.

Every effort was made to stimulate the loyalty and cooperation of the members of the department, and the Fresno department now stands in a class by itself, with reference to the morale and loyalty of its members.

Approximately $100,000 was spent during the early part of 1923 in buying new major apparatus. One new engine house was built in the packing house district. Approximately $40,000 was spent in remodeling and rebuilding Engine House No. 2, and here fire department headquarters and headquarters of the fire prevention bureau are now located. A new three-story re-enforced concrete addition was added to this building and in the third story are the night quarters of the chief. A complete new fire alarm system was installed with its central office in a location protected from conflagration attack.

A large amount of minor equipment in the way of smoke helmets, nozzles, forcible entry tools, additional salvage covers and so on was purchased, and a standard winter and summer uniform was adopted so that the members are now able to purchase a winter uniform for around $42.00 which gives them infinitely better service than the uniform which they were formerly able to purchase at random at from $60.00 to $65.00.

An educational campaign was inaugurated in the department with the idea of teaching the members something about their jobs. It is compulsory for each company commander on each platoon to hold two schools in company quarters each week. One of these schools is given over to first aid work, study of the rules and regulations, building construction, hydraulics, hazardous buildings, streets, hydrants, etc. The other is confined to house training with the equipment on the apparatus, discussion of such equipment, its location on the apparatus, its name, its use and misuse. Then the district chiefs of each platoon and district assemble the company commanders at district headquarters once each week where a school is conducted on hydraulics, chemistry, ventilation, and other phases of modern fire control. Once each month all of the officers on each platoon are brought to department headquarters, where a school is conducted by the

chief on these and related subjects. On each Wednesday afternoon all of the chief officers of the department meet at headquarters for the review and conduct of department business. On each Thursday afternoon the chief officers meet at headquarters for a normal school in all methods pertaining to fire control. The Bureau of Mines rescue squad has made several lengthy visits to Fresno for the purpose of thoroughly drilling the fire department officers and members in first aid and rescue work.

In addition to the training above indicated every member of the department was given a thirty-day course at the drill school, and those who graduated have been awarded appropriate diplomas. Every new member coming into the department must take a thirty-day course at the drill school before he is certified for appointment, or permitted to be assigned to a company. Fresno's drill school or fire college has been pretty well recognized in the West and a number of prospective drill masters from outside departments have taken the drill course and graduated therefrom. This will indicate the splendid educational work and schooling which is carried on in the department as a matter of regular routine.

In addition to all the work which has been done in the fire department proper, an intensive fire prevention campaign was inaugurated at the time of the reorganization of the department and the results of this campaign are self-evident when the reduction in fire losses is considered, and particularly the reduction in the number of alarms received. During the year 1923 some 48,000 inspections were made by the fire prevention bureau members of the fire department. In 1924, 58,000 inspections were made. One hundred and fourteen buildings of various types and construction were condemned, demolished and removed in 1923, and 117 in 1924. Some 87 public fire prevention meetings were held and addresses given in each case not only by members of the department, but by chiefs and officials from other cities. Talks are made to luncheon clubs, fraternal organizations, churches, corporations and organizations of like nature on occasion. On January 24, 1923, a public fire prevention mass meeting was held in the Civic Auditorium, which was attended by some 4,000 people. This public mass meeting was held again on January 23, 1924, and it is planned to make this an annual affair with different programs each year.

While Fresno was suffering from the low morale reflected in the constant burnings from carelessness, the firebug naturally found his opportunity. Arson was rampant. During 1921-22 there were three arrests made for arson, but the officers were unable to get convictions owing to the lack of interest of the public as jurors and inability to understand how difficult it was to secure evidence in these cases.

Immediately there was started a campaign through the public press

to educate the people as to their duty as jurors in cases of arson, and to the important part arson had played in Fresno's tremendous fire loss. This campaign showed the results in the next few cases that were tried before the court.

When Captain Williams was made fire marshal, he investigated the cause of every fire and published the result. No better educational work than this could be done. To Captain Williams belongs the credit for driving the firebugs from Fresno. Whenever he discovered evidences of over-insurance he took the matter up directly with the fire insurance companies issuing the indemnity, the effect of which was to stimulate the local insurance agents to greater care in the writing of policies. The local insurance agents cooperated loyally in the general fire-safety campaign. They reflected great credit upon their business in Fresno.

During the year and a half period ending June 30, 1924, there were 22 arrests for arson and 18 convictions. Most of the people convicted are now serving terms in San Quentin prison. In the minor cases, particularly where children were involved, probation was extended by the Juvenile Court. The activities of the fire prevention bureau along these lines and the results obtained have brought the number of suspicious fires down to an absolute minimum and demonstrated how quickly when once the fire prevention consciousness takes possession of a city the fire bug is eliminated from the problem.

A striking accomplishment of the reorganized Fresno fire department is the emphasis placed upon saving property from water damage, which Chief Baird considers as logical a fire department service as fire extinguishment. Salvage work was first undertaken by the department in 1922-23 and has since been enlarged upon and developed to a high degree of efficiency. While Captain J. J. Conway of Cincinnati, the dean of the fire patrol officers in America, was in Los Angeles for the purpose of instructing the proposed Los Angeles fire department salvage corps, he was requested to visit Fresno for the purpose of inspecting and training the men in salvage work. He appeared at the drill tower and at his request a company was sent for to illustrate the salvage and covering work as practiced in the Fresno department. On their arrival Captain Conway took charge and the result of the work was so satisfactory as to warrant Captain Conway in stating that there was no necessity for his remaining, as the work was being carried on in accordance with standard and modern practice, and that all that was necessary to complete the training of the Fresno men was practical experience.

Intensive training in all angles of salvage work is carried out through every branch of service in the department, and included in the standard equipment of each piece of apparatus are as many salvage covers as can

be conveniently carried. The squad company carries 21 covers, the truck companies 20 covers each, chemical companies and engine companies from four to six covers each.

The introduction of smoke helmets has within the last year and a half saved the city thousands of dollars in fire losses because of the fact that on a number of occasions the chief was able to send a helmet squad into basements and other places where the smoke and fumes were too dense to permit the entry of an unprotected fireman. In this way the origin of the blaze has been discovered and the fire handled with a minimum amount of damage.

An outstanding demonstration of the value of the salvage work of the Fresno department was, however, given at the Seventh Day Adventist Church fire which occurred on December 8, 1923. The interesting feature of this fire is the fact that while the roof and belfry tower were completely demolished, not one dollar's worth of property was damaged under the ceiling line either as a result of fire or water. The squad company covered everything in the church completely, with the result that no water damage was done to the pipe organ, furniture, piano or library. This has been considered by interested officials one of the most striking examples of the possibilities of proper salvage work which has been given anywhere during recent years.

Besides the salvage work is the work of the rescue squad, well drilled in first-aid evolutions and life-saving tactics. The rescue squad wagon was designed, constructed and equipped in the fire department's own shop and carries over 300 pieces of equipment. Four lives have already been saved by this squad since its organization. The building of this squad wagon is not the only accomplishment of the mechanics in the department. A double 80-gallon truck with 40-gallon auxiliary chemical engine was constructed and equipped in every detail in the fire department shop. This apparatus as it now stands cost the fire department something less than $2,200, while new factory-built apparatus equipped as this one is equipped would cost in the neighborhood of $9,000.

It goes without saying that the work of the fire department in public education in cooperation with the citizens' fire prevention committee has been up to the standard of any part of the country. Beside the constant daily inspections of the uniformed firemen in the business district, the annual one-day inspection is made of every building in the city. This one-day inspection is preceded by wide advertising in the newspapers, talks at the various luncheon clubs, fraternal organizations, churches, etc. It results in the inspecting force finding the city practically free from rubbish and other hazardous conditions on the day on which the inspection is made.

There is nothing surprising in the fact that Fresno should have won the silver trophy offered by the late Thomas H. Ince, motion picture magnate, to the city on the Pacific coast making the best fire prevention record. Mr. Ince was greatly interested in the Pacific Coast Association of Fire Chiefs, of which he was an honorary member, and the trophy, a mammoth silver cup, was received by Chief Baird on behalf of Fresno, and the convention of the association at Pasadena in August 1924.

The fire department under Chief Baird has won the most grateful regard of the Fresno people for its work in the schools. Chief Baird regards the safety of school children and hospital patients as his especial responsibility. There is one fire department inspector who does nothing during the school period but inspect schools and work with the school children. The schools are all given two drills each month and each school is assembled at least once each month and given a short talk on some particular subject of fire prevention. During the last Fire Prevention Week the different schools held contests on both fire prevention essays and posters.

At each time the children are assembled in the yard or assembly room, a fire alarm box mounted on a board is demonstrated and the proper method of sending in a fire alarm is explained together with the proper method of sending in an alarm over the telephone. In these fire drills at the schools certain pupils of each room are designated to see that all doors are opened upon the sound of the fire alarm, also to see that all pupils are clear, and the doors then closed. They are also instructed in the proper method of operating the hand fire extinguishing agencies in the school.

Structural changes have been made in the high school auditorium, and the basement and stage sections equipped with sprinklers. Similar improvements have been secured in the county hospital and old people's home. The safeguarding of these public buildings against loss of life and property by fire is the direct result of a forceful and competent fire chief moving for such conditions. The Board of Education keeps step with the fire chief in all his ideas and efforts for the safety of the children. What Chief Baird thinks about the responsibilities of the janitors of public school buildings is reflected in the following letter from the Board of Education:

Chief, Fresno Fire Department,
City Hall,
Fresno, Calif.

Dear Sir:

At a regular meeting of the Board of Education, held on June 12, 1924, the Board of Education of the City of Fresno Schools adopted the following ruling to be known as Section No. 8.

"All janitors employed by the Board of Education of the City of Fresno Schools shall be required to take a course in Fire Prevention outlined by the Fire Prevention Bureau of the Fresno Fire Department. On or about the first of February each year, the Secretary of the Board shall arrange for a written examination to be given all janitors who have not a certificate showing that they have successfully completed this course; such certificate should be issued upon the recommendation of the Fire Prevention Bureau of the Fresno Fire Department, after such examination as may be prepared by this Bureau, subject to the approval of the Superintendent of Schools."

Naturally the laws and ordinances of the city governing fire hazards have come up for review in this tremendous awakening of Fresno. The new penal ordinance passed during 1923-24 is a great improvement over the old ordinance, particularly with reference to fire prevention legislation, as under the new ordinance it is a misdemeanor for a property owner, agent or tenant to allow the accumulation of rubbish, or other material designated as a fire hazard. Under the new ordinance the usual two days' notice for removal is not required, but, instead, the mere presence of the hazard is a misdemeanor and warrants immediate arrest if the Bureau so desires. This has been a great help in promoting good general housekeeping. An oil storage ordinance and an ordinary governing theatre construction and operation have been adopted and a new building code has been introduced for passage with high hopes for early adoption. The county officials have helped the city by enacting an ordinance prohibiting the storage, sale, or discharge of fireworks within one-half mile of the city limits; also an ordinance requiring property owners to clean all grass and rubbish from their premises within the same area.

By all odds, however, the legislation in which Fresno is in the van of progress is that relating to the installation of automatic sprinklers. Following are the principal features of the sprinkler ordinance:

SEC. 2. The basement of every building other than private dwellings, after the passing of this ordinance, shall be equipped with an approved automatic sprinkler system. Before a building permit is issued for any such building, plans and specifications for the same shall be submitted to the Chief Engineer of the Fire Department. . . . The building permit for such building shall not be issued by the building inspector until such plans and specifications have been approved by the Chief Engineer of the Fire Department.

SEC. 3. No building hereafter erected in which a sprinkler system is required by the terms of this ordinance shall be occupied for any purpose until such sprinkler system is completely installed and in an operative condition.

SEC. 5. Every building (where the cost thereof shall exceed $2,000) erected, altered or reconstructed in whole or in part after the passage of this ordinance, used or intended to be used as a Planing Mill, Warehouse, Department Store, Furniture Store, Packing House, Paint Store or painting establishment, shall be equipped in addition to the basement, in every room or rooms, occupied by the hereinbefore mentioned occupancies, with an approved automatic sprinkler system. (There has been trouble with the ordinance on account of this section and it is proposed to raise the alteration exemption from $2000 to $5000.)

SEC. 6. The automatic sprinkler system shall comply with the requirements of the National Board of Fire Underwriters of 1922, provided, however, that a single water supply of a nature and capacity satisfactory to the Chief Engineer of the Fire Department shall be accepted as a minimum compliance with the ordinance, but in no case shall the supply pipes be less than four inches in diameter. A sprinkler shall not be required in safety deposit vaults used for the storage of records which would be subject to material water damage. In basements having an area of less than four hundred square feet, the supply pipe may be reduced to two inches.

SEC. 7. Violation of the ordinance is a misdemeanor. (Each and every day's violation constitutes a separate violation.)

Year after year through the payment of her excessive fire losses by the insurance companies, Fresno had mulcted her more prudent sister cities, from whom the premiums to pay these loses were collected. As a matter of social and economic justice no reduction in insurance rates should have been granted until Fresno had paid into the insurance fund of the nation the sums her years of indifference had taken from it. But no human being could desire to punish Fresno in the light of her social awakening of 1923-24, nor withhold the meed of admiration for the physical and educational accomplishment of these years. "Our activity," writes Chief Baird, "has never diminished since the reorganization of the fire department in November, 1922. We believe that practically 100% of the population of Fresno now realizes that in their own hands lies the solution of the fire prevention problem. They realize that they are well repaid when they keep their homes and places of business free from rubbish and other hazardous conditions; and they realize that this requires, usually, the expenditure of no money, but on the contrary, simply the exercise of ordinary common sense, coupled with a few moments' effort each day." Chief Baird dramatizes Fresno's accomplishment before her own people by compelling their attention to the following figures: For the five years from 1918 to 1922 inclusive, the average annual fire loss was $850,279. The average loss per fire for this period was $1,967. The average per capita loss was $16.13; while the average number of yearly alarms was something around 450. In 1923 the fire loss was $187,565, the loss per fire was $560, the per capita loss was $2.21, and the alarms had been reduced to 279. The fire department budget for the fiscal year 1923-24 was $404,620.05, and for 1922-23, the year prior to the reorganization, it was $367,640. Over against this expense array the tremendous reduction in fire losses following the new era of the department and the direct saving of $375,000 per year to the citizens of Fresno by reduced insurance rates, and the fire department appears as a self-sustaining proposition. In the residence sections the rates have been reduced from approximately $2.55 per hundred to a flat rate of $1 per hundred. In the mercantile district there has been a total reduction of some 35% on buildings and contents.

A contemplation of the mere facts of this story of Fresno projects before the mind a revised idea of the qualifications of the American fire department. The old political, pompous, water-throwing, sentimentally-regarded fire chief, hiding his ignorance and incompetence behind the shriek of sirens and clanging of bells, disappears from the picture and there emerges a quiet, intelligent, forceful, modest business man like Thomas Baird, who might with equal competence be administering a factory or directing a sales organization. There is no monstrous mystery about fire extinguishment or fire prevention; it simply requires the application of the same kind of intelligence that can successfully manufacture and sell soap; and some day when the economic significance of the fire waste is apprehended no American city will consent to leave its fire safety in the hands of a man no business organization would employ. Fresno in 1922 was as impossible from a fire hazard viewpoint as a city could be. Its delinquency had become a complacent habit. It needed, to awaken it, the dash of cold water from outside that many another American city needs. The service courageously and intelligently rendered Fresno by Jay Stevens liberated the local enthusiasms that have redeemed this Western city from her low estate. What one city may do another may do. There needs but the same sort of awakening to bring a similar rich fulfilment in prosperity and civic honor.

A Fire Prevention Pledge.

I pledge myself, that all this year,
I'll shun and dread and hold in fear,
Fire, and all its dangers great,
Before alas, it is too late,
And my home, so dear to me,
Is through the demon caused to be
A mass of charred and blackened wood;
And I, bereft, and my neighborhood
Threatened, if not called to pay
For losses made from day to day,
By children who with matches play;
Or cause a fire in any way.
I pledge myself, and will not shirk,
My due to others, and always work
To shield my home and city too.
I pledge myself, may I be true.

Every school child in Camden, N. J. has taken this pledge, prepared under the direction of John W. Kelly, Jr. (Member N.F.P.A.), Deputy Director of Public Safety.

Mice and Matches.

Despite laboratory tests showing that these rodents will starve to death in cages before gnawing matches of any kind, and the general belief that the "mice and matches" theory of fire has been completely exploded, this photograph seems to give definite evidence that in this one instance, at least, mice and a match were responsible for fire. This picture has been contributed by E. C. Smith, chairman of the Madison fire prevention committee, who writes about it as follows:

A man from a neighboring office came into my office this morning much excited and asked me if mice were ever responsible for setting matches on fire. I told him that they undoubtedly were. We went to his office and saw unmistakable evidence, entirely undisturbed, that a mouse had chewed a match and started a small fire, the results of which are shown in the photograph. A number of invoices lying upon the writing blotter and the ends of papers in pigeon holes above were burned.

Fortunately, the desk was tightly closed and the fire died out for want of oxygen, otherwise the entire office building would probably have burned, for the Fire Chief said that an open fire in it burning fifteen minutes would be beyond control. It appears that the owner of the desk had been keeping peanuts in it. These attracted mice and he had a trap set for them. Apparently a mouse in search of peanuts tasted a match that the desk owner recalled having left on it.

Causes of Railroad Fires.

Average number per year, 1919-1923.
Taken from Railway Fire Protection Association Statistics for 75 Railroad Systems.

CAUSE STATED	AVERAGE NUMBER PER YEAR	PER CENT OF TOTAL
Locomotives, sparks from	1800	20.9
Heating appliances and Flues	883	10.2
Locomotives, hot coals from	562	6.5
Exposure	521	6.1
Smoking	323	3.7
Tramps	316	3.7
Ashes and Hot Cinders	263	3.1
Lading; Charcoal, Lime, etc.	237	2.8
Spontaneous combustion	227	2.6
Torches	160	1.9
Incendiary	154	1.8
Electric Wiring	151	1.8
Careless burning of rubbish	122	1.4
Lighting appliances	121	1.4
Friction, Hot Boxes, Brakeshoes	101	1.2
Wrecks	92	1.1
Gasoline, Oils, etc.	75	0.9
Matches	64	0.7
Lightning	56	0.6
Forest Fires	50	0.6
Fuel oil systems	38	0.4
Tire heating	25	0.3
Waste and Wooden Lockers	22	0.3
Explosions	19	0.2
Boilers	14	0.2
Fusees	14	0.2
Fireworks	11	0.1
Miscellaneous causes	537	6.2
Unknown causes	1660	19.1
Total	8618	100.0

NOTE: This table is based on statistics compiled by the Railroad Fire Protection Association (Member N. F. P. A.). It has been prepared by the N. F. P. A. Executive Office to supplement Mr. Rapalje's article beginning on the next page.—ED.

Railroad Fire Hazards.

By deWitt Rapalje, Fire Prevention Engineer

Railroad Insurance Association (Member N. F. P. A.).

The purpose of this article is to outline briefly some of the fire hazards which are peculiar to steam railroads, and also to review some of the known fire causes of a general nature which are annually responsible for large losses to railroad properties and to merchandise which the railroads handle. Tables and statistics on specific hazards will be passed over with the mention of the fact that the annual railroad fire loss in the United States is about twelve million dollars.

Locomotives.

Doubtless the first picture which comes to mind at the mention of railroads, is that of the locomotive, and it is also the first concern in the matter of railroad fire hazards because the records show that the steam locomotive is the cause of a larger number of fires on American railroads, than any other individual item. Railroad officials have formed the habit of using the soft pedal when there is discussion of the locomotive as a cause of fire. This is because they have so frequently been placed on the defensive when claims are made by adjoining property owners for fire loss, said to have been caused by the locomotive. It is true that many such claims have been without proof, but the fact remains that fires known to have been caused by locomotives are more numerous than those under any other cause in the annual railroad fire loss statistics.

The locomotive is a fire hazard because it is a traveling boiler plant from which hot sparks and live coals escape and even flames from the furnace door are apt to be emited. As a fiery furnace on wheels traveling near many combustible structures and over wooden bridges, usually hauling a train of highly combustible cars loaded with combustible and at times explosive commodities behind it, it is easy for the layman to see how it can start fires.

In round numbers, the fires damaging railroad property caused by locomotive sparks, exceed two thousand annually and those caused by hot coals from locomotives, amount to over five hundred a year in this country. Many assumed "spark fires" are also caused in properties of others adjoining the railroad line.

Many precautions are taken to prevent sparks and live coals from leaving the locomotive, which have lessened these hazards but have by no means eliminated them. A front end design which could absolutely

When a train of loaded oil tank cars is wrecked, a bad fire is apt to result.

keep live sparks from passing out of the locomotive stack would be one of the greatest aids to the prevention of railroad fires which can be imagined. Also an arrangement of the ash pan which would prevent any coals from dropping to the ground except when the pan is dumped would be very helpful. Fires from the latter cause can be checked to some extent by placing a heavy wire netting over the draft space at the edges of the ash pan and arranging the lever to ash pan door in such a manner that coals can not be dumped except by a man standing on the ground.

Pending further mechanical improvements in locomotive design, the chief reliance for lessening the fires caused by this motive power must be placed in a closer and more frequent inspection of these safety devices.

Train Wrecks.

Railroads also suggest wrecks, and here is another fruitful source of railroad fires which annually burn up thousands of freight cars and their valuable contents. When a smash-up occurs or a string of cars leaves the track to go rolling down an embankment, it is easy to see that the chances for a resulting fire are very great. Splintered woodwork, combustible merchandise of many kinds, even gasoline or explosives may be part of the lading of the train, and frictional sparks are a frequent by-product of the crash which complete the setting for a lively blaze. The same precautions that are applied as safety measures in train operations are also the means of reducing fires from wrecks, collisions and derailments; good construction and maintenance of track and bridges, improved car construction, inspection and maintenance and the safe loading of hazardous commodities in transit.

Hazardous Freight.

Hazardous freight is often the direct cause of fires in railroad equipment and structures. When we consider that almost every raw material, commodity and product known to man is used in our vast industrial life today and that at some stage of its progression from the source to the ultimate consumer each of these products has to take one or more railroad trips, we see the great possibility of fires from hazardous freight. Explosives, dangerous chemicals, acids, oils of many kinds, gasoline, compressed gases, cotton, hay, excelsior and fibers of many kinds, celluloid products and an unending list of materials which are not only food for flame but often hazardous in themselves, are daily traveling along on the freight trains of the country.

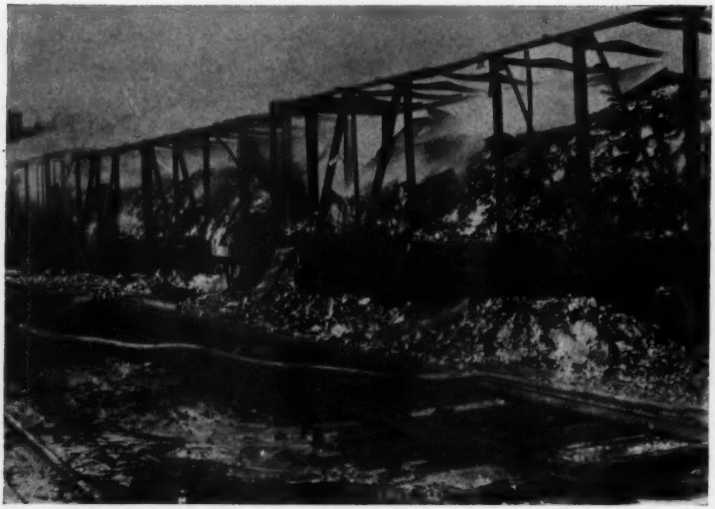
Reduction of the fire loss on railroads from hazardous freight has been looked upon by Congress as of such importance that detailed regulations for the handling, transportation and storage of explosives and other dangerous articles are prescribed by the Interstate Commerce Commission. The Bureau of Explosives (member N. F. P. A.) is engaged in educational work on the railroads and the promulgation of the rules covering containers, safe loading, transportation and safe storing.

The Trespass Hazard.

The "trespass hazard" is a name given to a group of fire causes not confined peculiarly to railroads, but one to which the nature of railroad properties makes them very susceptible. Each year we find a large number of fire losses in the railroad figures which are assigned to such causes as "incendiarism," "trespassers," "tramps," "boys," "bonfires," "burglars," "camp fires," "train robbers." So fruitful is this group of causes in producing railroad fires that in one year we find 640 fires reported by 75 railroads from the "trespass hazard" which was about 7% of the whole number of fires which these roads suffered that year. Railroads maintain special agents and private police service largely to combat the "trespass hazard" for the reduction of theft and fires, but the guarding of equipment and structures scattered over large mileages and so generally accessible is a very difficult thing.

Car Heaters.

Car heaters used to protect perishable freight, such as fruit and vegetables, from freezing temperatures are used quite generally on our northern lines and consist of stoves of various types, usually oil heaters, coal stoves or charcoal burners. Fires are caused every winter from car heaters, both those of special design and the temporary installations. The theory of the heater designs is usually good, but inadequate inspection and poor maintenance are the features of their operation from which



Train of box cars burned on a siding, showing contents still smouldering.

failures and fires generally arise.

Brief mention will be made of some other fire hazards which are of the railroad family but which do not present any marked fire prevention problem other than the need of eternal vigilance.

Other Railroad Hazards.

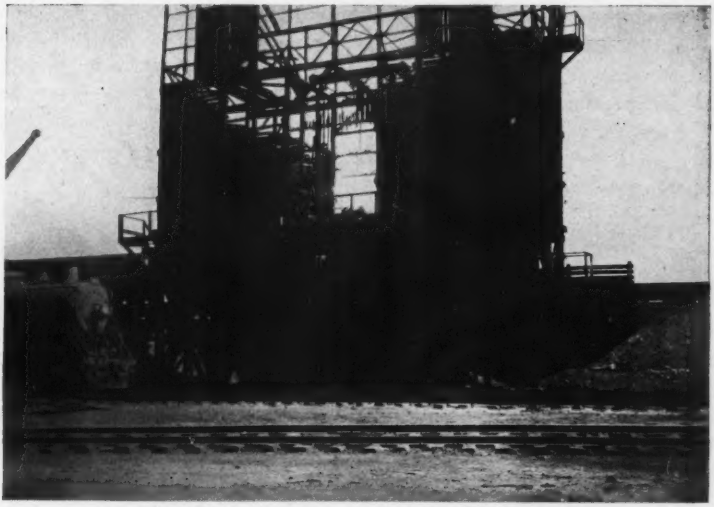
Hot cinders are hauled in vast quantities on railroads, chiefly from the locomotive ash pits, and this lading annually sets fire to many cars. The use of steel gondolas exclusively for hauling cinders would remove this source of fires.

Railroad fusees and torpedoes are "fireworks" used in train signaling and should be handled and stored with as much consideration as is shown for the "Fourth of July" variety.

Torches of the open flare variety are now generally obsolete in industry and in mining, but the old time railroader dearly loves his "torch" and this hazard is usually found around the average engine house plant.

Tire heating is done in locomotive repair plants and the fire hazard lies in the oil burner used to produce a ring of flame around the driving wheel tire for expanding the steel prior to removal or shrinking it on the wheel. Gasoline is often carelessly used in these heaters. This is a dangerous practice. Kerosene burners are safer.

Hot boxes on car journals frequently start fires on rolling equipment, but these as a rule are easily detected and quickly extinguished.



Typical fire ruins—locomotive coaling station.

We will now refer to some of the fire hazards which are common to many industries other than steam transportation, but which are of great interest to railroad managements and insurers of railroad property because they contribute so heavily to the railroad fire records. These are chiefly fire hazards of manufacturing processes found in railroad shop plants, which form a very extensive auxiliary part of our steam transportation systems. Bear in mind that all of the fixed properties, shops, warehouses, piers and other incidental structures of railroad property have a valuation of approximately seven billion dollars, which is about twice the value of all the railroad cars and locomotives in America, and you will see the importance of fire prevention measures in these fixed properties.

In a typical railroad shop plant, repair work of all kinds on locomotives, freight cars and passenger cars is carried on, and in many of the larger shops, engines and cars are built in their entirety, involving a great variety of shop fire hazards.

Fuel oil furnaces are generally found in the shops for forge work, babbitt heating, rivet heating and heavy metal work, introducing oil fuel systems which are often quite extensive and should require special care in their installation to protect the supply tanks and distributing pipes from rupture by heavy materials handled.

Oxy-acetylene equipment is used extensively for cutting and welding work on the steel parts of cars and involves the hazard of complete local

acetylene generating plants and distributing pipes at the larger shops, while cylinders of compressed acetylene and oxygen are handled freely and distributed to all points where any railroad repair work is done. Special precautions are necessary.

Gasoline is found in general use in many railroad buildings for many purposes but the cleaning of air brake valves is one use in which this popular fire starter is especially related to steam railroads. No tanks or cans of gasoline should be permitted in the air brake cleaning room except when the work is actually under way and then "safety" cans only, and this room should preferably be separated from the other shop occupancies. Gasoline used in rubber cement for air brake hose work should be treated with the same respect.

Car painting is done extensively in coach shops and freight car repair buildings and involves all the hazards of paint and varnish storage, mixing and applying to the car exterior and interior, also the very serious fire hazards of *paint burning* and *varnish removing* by liquid removers which have been the cause of some very extensive fire losses. The paint shop building should be a detached structure and quite distinct from the building in which car repairs or woodworking are carried on. This building should be sprinklered and no acetylene cutting or welding work or any open lights or smoking permitted therein. The stock of paints, oil, varnishes and turpentines should be kept in a detached paint storage building. The "varnish removers" should be applied out of doors wherever practicable, and never near an open flame or light.

Woodworking hazards found in the planing mills, cabinet shops, pattern shops and carpenter shops of any railroad repair plant are similar to those present in these familiar occupancies at any factory and involve the same treatment for fire prevention.

Lumber storage is present to a greater or less extent as a fire hazard at most railroad shops and tie and timber storage is very extensive at the large railroad creosoting plants.

Upholstering work is a very important part of a railroad coach repair plant and the process brings in the hazard of the picker room for cleaning hair, moss and fiber, the storage of these materials, and seat and cushion cleaning for which flammable compounds are often employed. The upholstery building should have sprinkler protection.

A few more of the well known hazards which are to be found in a railroad shop plant will be named as follows: buffing, lacquering, japanning, dip tanks, battery charging, electrical repair work, reclamation of materials, chemical laboratory work, burning of old car bodies, shavings disposal, sand drying, blower systems, blue print drying, tin and coppersmithing, foundry hazards and flask storage, Pintsch gas generators.

Result of recent fire at the repair shops of a large Railroad.

wooden lockers, oil tempering, acids, rubbish and sweepings disposal. There are also the so-called common hazards of heating, lighting and power which do their proportionate share of mischief in these plants, as well as in industrial buildings, from the boiler house to the defective electric light cord; the common coal heating stoves being a most active offender.

Special Buildings.

Railroads use large quantities of oils for lubricants and signal purposes, so we find an *oil house* of considerable size at each important shop plant. These can be made quite safe if the best practices are followed, viz.: concrete construction throughout, all tank storage in basement, main floor to be used for pump deliveries and distributing purposes only. Gasoline stock or other highly volatile oils to be kept in isolated underground tanks only. The oil house should not be located near important shop buildings and should be supplied with approved foam type fire extinguishers and vapor proof electric globes; no switches or key sockets in building and no smoking on premises. Dope or journal packing is generally mixed and cleaned in the oil house. The dope and waste room should be cut off from the oil room.

The *round house* does not stand out as a very hazardous occupancy, although it is the smokiest building and the one whose design is most typical of railroad use. Smoke jacks should be of incombustible material so that the locomotives will not set them on fire. Engine pits should be

kept clean and proper safeguards should be followed in firing up locomotives and in cleaning the exteriors where oil emulsion sprays are used.

Taking up some other classes of railroad property we come to locomotive *coaling stations* which are generally of timber construction and form bad fire risks. The fine coal dust which collects in these structures together with the oil from machinery bearings and liability of frictional or electrical sparks form a bad combination. On account of the difficulty of fighting fires in these high coal pockets from the ground it is best to equip them with sprinkler systems. Storage of bituminous coal in piles of large extent on the ground is also indulged in by many railroads and frequently results in fires in the coal from spontaneous ignition due to improper piling.

A *pier* is not a "fire hazard" but it forms a peculiarly difficult type of structure in which to fight a fire because there is approach by land at one end only. At most of our seaports a large proportion of the pier structures are railroad properties used by them as freight terminals and temporary warehouses for the assembling of ship cargoes of all kinds and of great value. Pier fire losses usually run to large figures in dollars per fire. Good fire boats, standpipe systems and automatic sprinklers and fire alarm installations are among the important protection items for piers. Recently the N. F. P. A. has concluded and approved a comprehensive treatise on piers and wharves, their construction and protection.

Grain elevators are located at many railroad terminals and are often owned and operated by the carrier. Their fire hazards are a topic by themselves and a very serious one, as the inherent dust explosion danger is always present. Railroad fire loss tables have been frequently embellished with large grain elevator fires. Automatic sprinklers are certainly indicated for every grain elevator work house. Fortunately the old wooden type of elevator is fast being replaced by the modern concrete structure and an improvement from a fire risk standpoint as well as from an operating economy.

The "Smoking" Hazard.

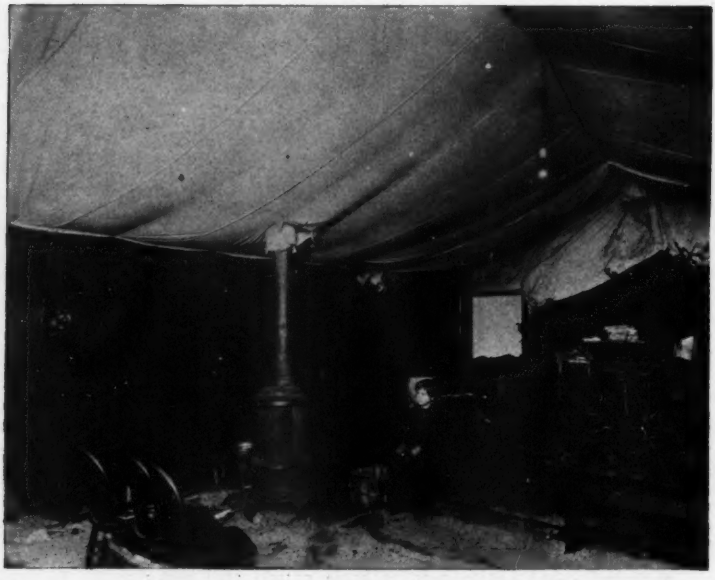
This article began with reference to the locomotive fire hazard and locomotives often do a lot of smoking, but there is a more promiscuous smoker and a greater fire hazard on the railroads, and that is the careless employe. Matches and smoking among the known causes reported annually appear to average over 300 fires and about half a million dollars of railroad property burned, but no doubt many of the fires of "unknown" origin may belong in this group. Efforts to reduce this hazard which consist only of posting "No Smoking" signs at every conceivable point are frequently misdirected and are of about as much value as a fuel economy

Loss of over $2,000,000 in a railroad car yard when 164 cars were destroyed, most of which were loaded with valuable freight.

campaign would be which consisted of tacking a "No Smoking" sign on the front end of every locomotive.

Railroad employes generally have rough and dirty work to do as their daily task and efforts to convert them all to the non-smoking class are bound to meet with scant success. Most of them want to smoke and do so regardless of all the signs.

Smoking is a general habit and should be provided for by railroad managements for their employees on the same principle as that followed in providing facilities for passengers who smoke on trains and at stations. Provide safe and suitable smoking rooms for railroad labor and this serious fire hazard can then be controlled and eliminated from the dangerous occupancies. Rules against smoking can be enforced if they are applied only at the hazardous spots. The railroad record room is a case in point. Fire inspectors are constantly reporting evidence of smoking in the typical record room where large quantities of paper files are stored to comply with the requirements of the law and generally one of the worst places for a cigarette butt or burning match to be left to its own inclinations. The file clerks smoke in these rooms because they can do so there without detection while the office in which smoking might be safely indulged is filled with prohibiting signs.



It Did *NOT* Burn.

A setting as bad, if not worse, than that which caused the death of 36 persons at Babb Switch, Oklahoma, on Christmas Eve, is illustrated by this picture which appeared in the Wichita, Kansas, *Eagle* recently. It was sent to us by H. A. Blinn, Manager of the Wichita branch of the Kansas Inspection Bureau (member N. F. P. A.). The remarkable feature of this situation is that there was no fire! Chief Al Brownewell of the fire department believes it is just plain luck that the Babb Switch episode was not repeated in Wichita. On hearing of the place he ordered it closed.

Bunting on the roof, as shown in the picture, was placed there for no purpose but to look pretty. Note the stovepipe passing through it and the cord of the electric light. And on the floor are *shavings,* not sawdust. The windows are covered by the evergreen trees. The only exits are two small-sized single doors, yet 200 little children were in this building on Christmas Eve and gatherings have been held in the place subsequently.

The man in charge of this room, when the hazards of the place were indicated to him, and with the recollection of the Babb Switch tragedy fresh in his mind, broke down and cried. "He is a good man," commented the Fire Chief, "but just thoughtless."

$535,372,782 in 1923.

Final loss statistics for 1923, as compiled by the Actuarial Bureau of the National Board of Fire Underwriters (Member N. F. P. A.) show the total fire loss in the United States to be $535,372,782, the largest annual loss ever recorded. The loss in 1922 was $506,541,001, in 1918 was $353,878,826, and in 1913 was $203,763,550.

As indicated by the accompanying table, *Matches—Smoking* continues to be the chief cause of fires, and the next three causes, *Defective Chimneys and Flues; Stoves, Furnaces, Boilers and Their Pipes;* and *Spontaneous Combustion,* hold the same relative position of importance.

U. S. FIRE LOSSES COMPARED—1922-1923.

(Known Causes in Order of Importance)

CAUSES	RECORDED LOSS. 1922	1923
Matches—Smoking	$25,776,951	$29,045,007
Defective Chimneys and Flues	18,550,433	20,828,162
Stoves, Furnaces, Boilers and Their Pipes	16,676,784	18,658,248
Spontaneous Combustion	14,594,799	16,110,945
Sparks on Roofs	11,875,719	15,931,342
Electricity	11,918,572	14,091,789
Petroleum and Its Products	10,232,800	11,183,421
Lightning	11,513,725	10,922,669
Sparks from Machinery	7,809,853	7,499,699
Sparks from Combustion	4,825,101	6,533,542
Hot Ashes and Coals, Open Fires	4,069,690	5,365,014
Gas, Natural and Artificial	3,538,372	3,819,274
Open Lights	2,633,692	3,332,191
Explosions	2,797,953	3,064,198
Ignition of Hot Grease, etc.	1,470,878	1,740,418
Incendiarism	2,708,328	1,622,987
Rubbish and Litter	984,643	1,576,433
Fireworks, Firecrackers, etc.	775,203	639,131
Steam and Hot Water Pipes	187,296	419,586
Miscellaneous Known Causes	5,115,583	6,470,790
*Exposure (including Conflagrations)	61,917,414	69,030,839
Unknown Cause	185,259,010	180,373,441
Total	$405,232,801	$428,298,226
25 Per Cent to Cover Unreported Losses	101,308,200	107,074,556
Grand Total	$506,541,001	$535,372,782

*Losses due to spreading fires originating from various causes.

NOTE: This data was published by the National Board of Fire Underwriters in *Safeguarding America Against Fire* for January 1925. This publication is mailed regularly to N. F. P. A. members, but the data on fire losses is partially summarized herewith so that it may be included in the permanent records of the N. F. P. A.

Serious increases are noticeable in *Open Lights* and *Rubbish and Litter*, while fewer fires due to *Lightning, Sparks from Machinery,* and *Incendiarism* were reported.

New York suffered the heaviest loss, its total being $55,866,672. Other states with large losses were Pennsylvania ($31,390,858), Illinois ($29,033,997), California ($26,079,490), and Massachusetts ($22,138,994).

Repair of a Fire-Damaged Building.

The disastrous fire in the Sterling Products Company building, Evansville, Ind., was described in detail in the October, 1924, QUARTERLY, page 190. The pictures on the opposite page show the character of the damage and how it was repaired.

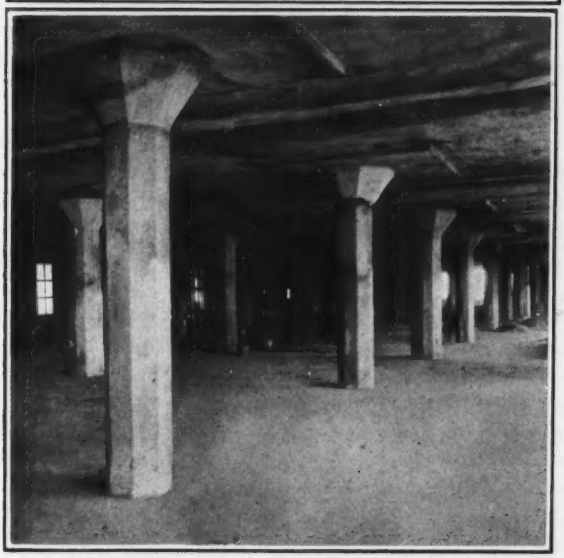
The damage to the building was excessive but not irremediable. Columns were spalled to the reinforcing and column capitals and drop plates were badly disintegrated. Large cracks also appeared in the roof slab. These cracks invariably followed the construction joints or bulkheads used when pouring the slab.

In order to repair the columns it was first necessary to remove all loose and disintegrated concrete. In most cases this meant taking off everything outside of the spiral reinforcing. In no case was this less than 2 inches. This was done with pneumatic chipping hammers. Concrete was then shot against these columns by means of a "cement gun," building them up to their original dimensions. The column capitals and drop plates were also cleaned off and built up in this way to their original dimensions.

In repairing the floor slabs all loose and disintegrated concrete was first removed and the entire underside of the slab cleaned by sand and water-blast. In many places, particularly along construction joints, this necessitated cutting the slabs clear through, thus exposing the reinforcing bars for a width of from 3 to 15 inches. "Guncrete" was then shot in place, replacing all the defective concrete that had been removed and coating the underside of the slab, restoring all surfaces to their original lines.

In order to determine the advisability of repairing the building with "guncrete," one of the worst panels was repaired by this method and after allowing it to set for 25 days it was subjected to a test load. The results of this test showed the panel to be fully restored to its original designed strength.

Photographs and data furnished by courtesy of *Engineering News Record.*



Above—Fire damaged Sterling Products Company Building. Below—After repair by method described on opposite page.

Legislation Against Fireworks.

Fireworks are now responsible for a money loss of from $700,000 to $800,000 annually. This is nearly double what it was six or seven years ago. The American Medical Association, which compiled statistics as to loss of life from the celebration of the Fourth of July, stopped doing so in 1915, so data as to the present extent of loss of life is not available. In the 13 years between 1903 and 1915 during which records were kept, a total of 1,862 persons were killed and 42,089 injured in using fireworks on the "Glorious Fourth." All accidents not due directly to fireworks are omitted from this total. Of the 1,862 deaths, 1,143 were due to "lockjaw," 217 were burned to death, 199 killed by firearms, 116 by explosives; giant crackers, toy cannons and various forms of fireworks accounted for the rest.

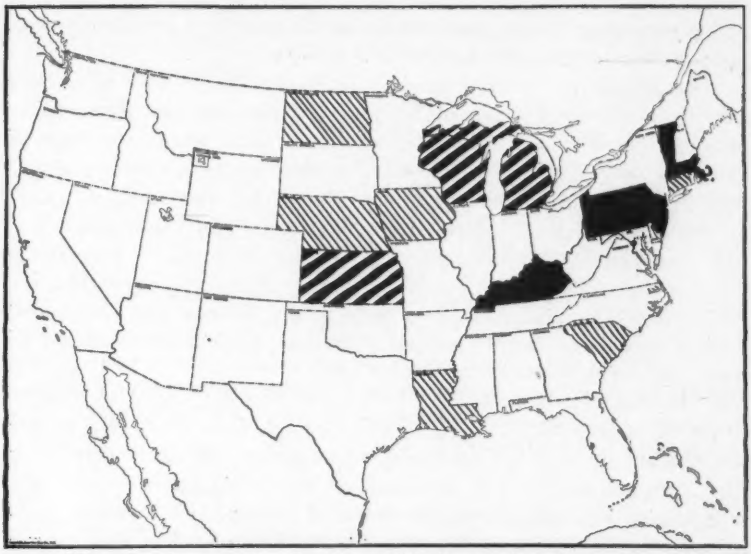
In 1910 the N. F. P. A. inaugurated a campaign for a rational celebration of the Fourth of July which was reflected by results as shown in the following table:

Year	*Dead*	*Injured*
1909	215	5092
1910	131	2792
1911	57	1546
1912	41	947

During the next three years, 1912 to 1915, no striking gains were shown, indicating that some of the old practices persisted in smaller municipalities and rural districts to which an educational program did not penetrate. Fireworks in addition to being used to celebrate Independence Day are used in the South during the Christmas holidays, and by Chinese in the West at New Year's.

Influenced by the agitation against the use of fireworks, most of the principal cities of the United States have instituted some kind of regulations governing their use. This has to a considerable extent abated the hazard to life and limb, though present control of this hazard is still far from adequate. Few existing laws are entirely prohibitory, as most of them permit some types of fireworks which do not poison or maim the users. In the enforcement of city ordinances much trouble has been encountered because of a lack of state legislation. "Bootleg" dealers can sell outside the city limits with impunity.

Only eight states have fairly comprehensive regulations restricting fireworks. These are, Kansas, Kentucky, Massachusetts, Michigan, New



Map showing extent of state legislation against fireworks. Black states have fairly good laws restricting or prohibiting fireworks. Heavily shaded states are those where regulations of fire marshal or state commission are enforced and have the effect of state laws of the kind in the states shown in black. Lightly shaded states are those having partially prohibitory fireworks legislation. White states have no laws on the subject.

Jersey, Pennsylvania, Vermont and Wisconsin. These laws range all the way from those such as Massachusetts' which are detailed and complete as to scope and method of enforcement, to laws which are scarcely a paragraph long but which leave the detail of interpretation and enforcement to the authorities. In Michigan and Kansas the fire marshal under state statute has authority to make regulations applying to fireworks and these are of a comprehensive nature and are like state laws in the manner of their enforcement. In Wisconsin the Industrial Commission performs a similar function.

Three states, Louisiana, South Carolina and Connecticut, have very limited state legislation. Louisiana prohibits poisonous fireworks; South Carolina, poisonous or highly explosive firecrackers; while Connecticut stipulates that firecrackers may be of gunpowder only and fired only on July 4th. Iowa, Nebraska and North Dakota have laws which are not particularly restrictive as they permit large sized firecrackers.

All of the other states except Oklahoma, on which data had not been received up to the time this issue of the QUARTERLY went to press, have no state laws against fireworks. Several were found to have statutes dele-

gating regulatory powers on fireworks to the respective cities and towns, but for the most part state legislation is deficient.

At present the greatest need in legislation is for laws which will effectively prevent the use of fireworks by children and irresponsible persons. To do this it seems necessary to prohibit the sale and use of fireworks altogether, except for public displays under supervision of fire department or other municipal officials, and for necessary uses such as railroad signaling. Most fireworks require the use of matches. "Matches—smoking" continues to head the list from year to year as the fire cause responsible for the greatest loss. Fireworks themselves are adding nearly a million dollars a year to the National fire waste, and because they do not serve a necessary purpose, to discontinue the use of them should not work any serious hardship.

The following summary has been compiled from replies received to letters of enquiry addressed by the N. F. P. A. Executive Office to fire marshals and other authorities in the various states. While the data is far from complete, especially in the detail of city ordinances, it is published as indicating in a general way the extent of existing anti-fireworks legislation in the United States. Contributions of data useful in correcting or adding to this summary will be welcomed from QUARTERLY readers by the N. F. P. A. Executive Office.

Alabama.

No State Law. Some municipal ordinances.

Arizona.

No state law. Prohibitory ordinances in the following cities and towns: Bisbee, Douglas, Flagstaff, Glendale, Globe, Mesa, Miami, Tucson, Williams and Yuma.

Arkansas.

No State Law.

California.

California has no state law except one which gives authority to boards of supervisors of counties to make laws and regulations on the subject. A bill prohibiting fireworks, except as to storage for trans-shipment, was defeated in the 1923 legislature.

Colorado.

No state law. Where municipal ordinances exist, there is usually a limitation placed on size of firecrackers and limiting the use of fireworks to celebrating July 4th.

Connecticut.

Firecrackers made of gunpowder only may be sold and used on July 4th only.

Delaware.

No state law. Wilmington has a fairly comprehensive ordinance which restricts the use of fireworks except for public displays with special permit.

District of Columbia.

A strictly prohibitory law is enforced. On rare occasions permits are issued for public displays.

Florida.

No State Law.

Georgia.

No state law. Eighteen cities or towns have adopted a model ordinance. Some form of ordinance is in effect in 24 towns, while fireworks may be sold, but not discharged within the fire limits, in 18 towns.

Idaho.

No state law. Boise and some of the other cities have fairly satisfactory ordinances.

Illinois.

Has no state law which applies to fireworks. There is a state statute on explosives, but the question of whether this also applies to fireworks has not been passed upon by the courts. There is a law which prohibits toy pistols which will shoot blank cartridges. Chicago is the principal city in the state which prohibits the sale of fireworks. In most other cities sale is permitted with or without ordinances on the matter. In the case of Chicago, which has an ordinance, trouble in enforcing it is encountered because, in the absence of state law, "bootleg" dealers in fireworks set up stands just outside the city limits and sell to the citizens of the city.

Indiana.

No State Law.

Iowa.

No person shall use, sell, offer for sale, or keep for sale, within this state, any toy pistols, toy revolvers, caps containing dynamite, blank cartridges for toy revolvers or toy pistols, or firecrackers more than five inches in length and more than three-quarters of an inch in diameter. This does not prohibit the use of dynamite caps for signaling or mining uses. Storage of fireworks is required to be outside the congested districts. Most of the larger cities of the state prohibit the sale and use of fireworks for celebrating legal holidays, and prohibit the sale and use previous to July 3 in the case of July Fourth. This law is generally observed.

Kansas.

Kansas has no law regulating the storage, sale and use of fireworks. However, acting under revised statutes of 1923, the state fire marshal has issued regulations governing the use of firecrackers as follows: No person, firm or corporation shall, within the State of Kansas, sell, store, keep for sale, or for any other purpose, any firecrackers of more than three inches in length, toy cannons, explosive caps to be used in cap pistols, colored fire sparklers, torpedoes, nigger-chasers, spit-devils, roman candles, sky rockets, or the germs of tetanus or lockjaw, intended for purposes of celebration or pyrotechnic display, when the said selling, storing and keeping is within one thousand feet of any building, barn, storehouse, or stack of grain or feed. Public displays are allowed with special permit.

Kentucky.

The discharge, firing and use of firecrackers, rockets, torpedoes, roman candles, or other fireworks or substances designed and intended for pyrotechnic display, and of pistols, canes, cannons or other appliances using blank cartridges or caps containing chlorate of potash mixture, is prohibited. Public displays are allowed on special permit. The chief of the fire department may remove at the expense of the owner stocks of fireworks exposed for sale. Firearms may not be discharged within limits of any city or town, or within 300 yards of a place where explosives are stored.

Louisiana.

Louisiana prohibits fireworks ignited by friction and containing white or yellow phosphorous, such as "spit devils" and "son-of-a-guns." New Orleans has no fireworks ordinance. Some cities which have had experience with fireworks plus shingle roofs prohibit skyrockets, roman candles and firecrackers longer than 2½ inches. In some instances this does not apply to private premises. As a whole these ordinances are very inadequate.

Maine.

No State Law.

Maryland.

No state law. Hagerstown, Frederick and Cumberland have fairly comprehensive ordinances, and one is under consideration by the city of Baltimore.

Massachusetts.

Massachusetts has a comprehensive law which places heavy restrictions on the keeping, storage, transportation, manufacture, sale and use of fireworks in the commonwealth. This does not apply to small firecrackers or display fireworks of limited size. Public displays are allowed by special permit.

Michigan.

Under statutory authority, the fire marshal issues regulations to the following effect: Except for public display with special permit, no person shall sell or offer for sale, or place on display within the State of Michigan, any blank cartridge, toy pistol, toy cannon, toy cane or toy gun in which explosives are used; the type of balloon which requires fire under it to propel the same; firecrackers, torpedoes, or any fireworks containing any explosive or inflammable compound or tablets or other device commonly used and sold as fireworks containing nitrates, chlorates, oxalates, sulphides of lead, barium, antimony, arsenic, mercury, nitroglycerine, phosphorous or any compound containing the same or modern explosives.

Minnesota.

Minnesota has no state law, but comprehensive city ordinances are enforced in Duluth, Minneapolis, St. Paul and other cities.

Missouri.

Missouri has no state law. St. Louis has a comprehensive prohibitory enactment.

Mississippi.

No State Law.

Montana.

Montana has given the cities of the state authority to enact prohibitory ordinances, but has no state measure that directly limits the use of fireworks.

Nebraska.

Nebraska prohibits the use, sale, offering for sale, or keeping for sale, any firecrackers more than five inches in length and more than three-quarters of an inch in diameter, or any toy revolvers for shooting blank cartridges, or blank cartridges for toy revolvers. Caps containing dynamite may be used for signaling, mining and elsewhere necessary.

Nevada.

No state law. The city of Tonopah has an ordinance.

New Hampshire.

No state law, except that the authority to make regulation pertaining to fireworks is vested in the towns of the state.

New Jersey.

New Jersey legislation prohibits the possessing, keeping, storing, using, manufacture, selling, handling or transportation of pyrotechnics, which it defines to mean any sparkler, cracker, squib, rocket, roman candle, fire balloon, signal light, railroad torpedo, flashlight composition, fireworks, or other device used to obtain a visible or audible pyrotechnic display. This does not prevent the necessary use of flashlight powder or railroad signaling devices.

New York.

New York has no state law prohibiting fireworks. New York City has a comprehensively restrictive ordinance.

New Mexico.

No state law. Where municipal restrictions exist they generally only limit the size of firecrackers or the use of fireworks to the period around July Fourth.

North Carolina.

No state law, although most of the important cities of the state do restrict or prohibit fireworks. This state has experienced difficulty in enforcing the city ordinances because dealers can sell outside city limits. The state fire marshal believes that a state law will be passed this year.

North Dakota.

The State Fire Law prohibits manufacture, use or sale, or keeping for sale, of blank cartridge, pistols, blank cartridge revolvers or other blank cartridge firearms, blank cartridge caps containing dynamite, and firecrackers exceeding three inches in length and exceeding one-half inch in diameter. The state delegates to municipalities authority to make local regulations, and in addition the fire marshal's department has considerable authority in the making and enforcement of supplementary regulations.

Ohio.

No state law is in effect although it has been repeatedly introduced into the state legislature. Most of the Ohio cities have ordinances prohibiting the sale of fireworks but they are unable to regulate the sale outside the city limits, which to a certain extent is felt to nullify the effect of the ordinances.

Oregon.

There is no state legislation, although practically every city in the state has a local ordinance. An order of the fire marshal's office was issued a few years back, which regulated the sale, use and discharge of fireworks and pyrotechnics, but on the advice of the attorney-general the fire marshal did not try to enforce those regulations.

Pennsylvania.

State law (1881) prohibited sale of weapons and explosives to minors; (1901) prohibited sale or manufacture of firecrackers containing dynamite, or any compound except gunpowder; (1905) prohibited fireworks and firecrackers containing picric acid or picrates, all explosive canes using chlorate of potash or other high-explosive ammunition or blank cartridges, all blank cartridge pistols, all pellets or tablets composed of chlorate of potash or high explosive compounds; (1911) prohibited firecrackers over six inches in length, firecrackers over three and one-half to six inches in length over three-quarters of an inch in diameter, and any firecracker to the length of three and one-half inches over one inch in diameter; (1911) prohibited any species of fireworks or pyrotechnics containing picric acid or picrates, tablets, pellets or cartridges containing dynamite or high explosive compound; (1915) prohibited fire balloons; (1919) act gave fire prevention duties to state police department; (1921) act gave authority to cities and towns of the state to make prohibitory regulations regarding fireworks. Many of the cities have issued ordinances under this act.

Rhode Island.

No state law. Providence prohibits firecrackers.

South Carolina.

The sale of any firecracker, bomb, or other explosive cracker exceeding three inches in length and one-half inch in diameter or any such cracker containing dynamite or substance that is poison when taken internally is forbidden.

South Dakota.

No state law although most of the cities of the state prevent the sale of fireworks.

Tennessee.

Rules of State Department of Fire Prevention limit the amount of fireworks that may be stored within town or city limits and are partly enforced.

Texas.

Texas has no state law except to delegate authority to the cities and towns, many of which have adopted a suggested ordinance issued by the state fire marshal's office.

West Virginia

No state law but it is probable there are some local ordinances.

Utah.

No state law. Salt Lake City has a prohibitory ordinance.

Virginia.

No state law although there are some local ordinances

Vermont.

"A person who has in his possession a cracker, squib, serpent or rocket with intent to sell or set fire to the same, or sells or offers to sell or give away the same, or sets fire to or throws a lighted cracker, squib, serpent or rocket, shall be fined not more than ten dollars."

Washington.

No State Law.

Wisconsin.

Certain sections of the state law prohibit the use of dynamites, picrates or chlorates of potash in fireworks, and the giving to children under 15 years of age, any compound containing poison. The Fire Prevention Division of the State Industrial Commission, which has jurisdiction and authority in this matter, has issued order as follows:

No firecrackers, sparklers, skyrockets, roman candles, torpedoes, bombs, toy pistols, toy revolvers, toy firearms, explosive canes or hammers, blank cartridges, explosive paper caps, son-of-a-guns, or other similar fireworks, appliances and displays, except wholesale storage in original, unbroken packages, shall be kept or stored in any place of employment or public building, or in any other place within 200 feet from a neighboring building.

Such fireworks, appliances or displays, except skyrockets and roman candles, shall not be discharged, fired or used within 200 feet from any building, nor shall skyrockets or roman candles be discharged within 500 feet from any building.

This order shall not apply to Chinese firecrackers not over two inches in length and one-fourth inch in diameter, colored fire in compact cases, light torches with lighting ends covered, or fireworks displays made under the direction of town or municipal authorities, provided the same do not violate the provisions of the statutes, and provided further, that no fire balloons or bombs shall be stored or used under any circumstances.

Wyoming.

No state law. Some municipalities limit size of firecrackers.

Methods of Fighting Forest Fire.

By George H. Wirt.
Chief Forest Fire Warden, Pennsylvania.

The object of forest protection work is not only to prevent forest fires but also to detect and control those which occur before they grow large. Forest fire does damage not only to present growth but also prevents valuable growth from becoming established on apparently worthless areas. Every forest fire does some damage. The efficiency of a Forest Fire Warden and his local organizations is determined by the time which elapses between the start of a fire and his first attack.

Quick action avoids expense, loss, hard work, and the probability of big fires. Small fires are easily subdued and permit every one's getting back to his regular work in a short time. It is true that fire fighting is more effective in the evening, night, or early morning, but it is extremely bad policy to wait until that time to begin.

A local alarm bell or whistle and a prearranged place of meeting, for the fire fighting force help greatly. In case other assistance is needed, use the telephone as far as possible or send messengers to various homes. A small, well trained, well equipped crew at the beginning of a fire is worth 50 to 100 men later. One man should be started to the fire at once to make investigations and be ready to report to the warden upon his arrival.

There are many methods of attacking a forest fire. Some are good and some are not. Some may think their method is the only one. A good warden is always ready to receive suggestions of value and is willing to give them fair trial at least. Methods of fighting vary with the character of the fire, character and condition of the forest, condition of atmosphere, strength and direction of wind, rapidity of fire's advance, topography, material on ground, etc.

Hollow Tree Fires.

Hollow tree fires are stopped by shutting off the air which makes a draft through the hollow trunk. Close the hole at the ground if possible with dirt. If this cannot be done, the ground around the burning tree should be cleared, and the tree should be felled. The fire can then be smothered inside and outside. If water is available, the fire may be put

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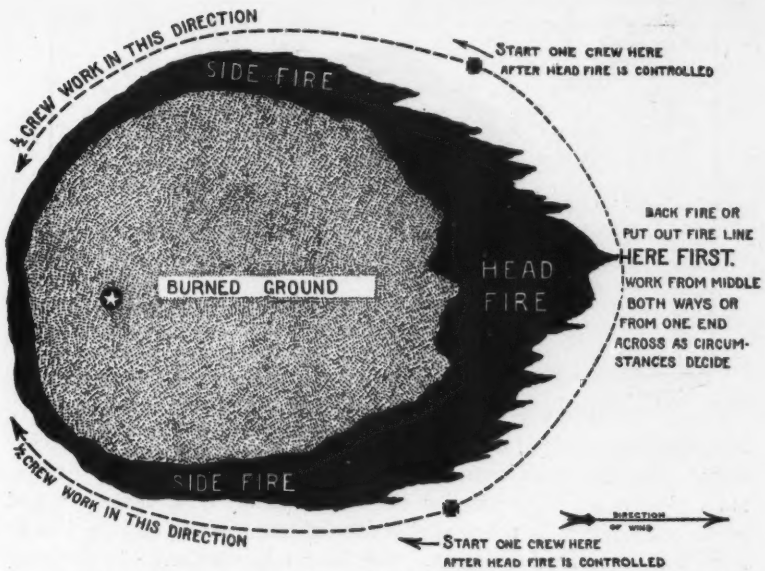


The correct way to attack any forest fire. Always work from in front toward the rear. Stop the head-fire first and work far enough to each side so that the side-fire cannot work around to a new head-fire.

out with force pump or sprayer or chemical extinguisher without felling the tree. Dead snags in forests should be felled as a matter of fire prevention as well as for the benefit of the forest.

Underground Fires.

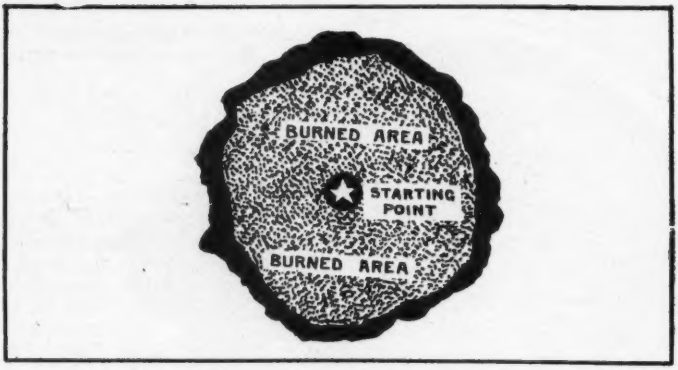
Underground fires can be stopped only by digging deep enough to prevent their spread. The ditch, as well as the surface, should be flooded if possible. This, however, is seldom possible. Where an underground fire has a good start it may be cheaper to blast a ditch than to dig one. Well-placed dynamite will do effective work in a short time.

Crown Fires.

We have few crown fires in Pennsylvania. Natural conditions as to topography and growth are the best means of stopping any that may occur.

Surface Fires.

Surface fires are the kind which occurs most frequently in Pennsylvania. If there is little wind the flames may be put out by beating with branches (pine preferred), shovels, and wet burlap. Fire fighters should beat the flames with a side sweep toward the fire to avoid spreading sparks. Sweeping with old brooms, brooms made of branches, or steel brooms, is better than beating. The burning material may be pushed



How a forest fire burns when there is no wind.

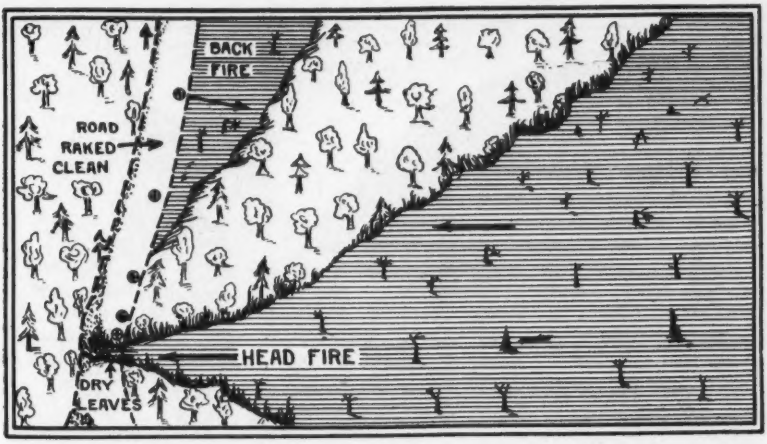
back upon the burned-over ground with rakes, sticks, forks, or other tools. The idea is to separate the burning material from that not yet afire. Water is always effective, but too frequently dependence is placed on it, and when it is not available fire fighters seem to be at a loss to know how to make their attack. The fire can be smothered by throwing on dry or moist sand or dirt. If it is possible to plow, a furrow may be thrown up quickly to restrict the spread of the fire.

Sometimes small or lightly-burning fires are beaten out. If no trail is cleared to the bare ground entirely around the burned area, here and there small pieces of smouldering wood may be fanned into flame and the fire may again break out. It is always a safe practice to make a clean trail with exposed mineral earth entirely around the burned area.

Chemical extinguishers are sometimes used. Careful tests have been made by foresters and it has been found that the chemical spray is of no more value in the woods than is plain water with a little force back of it. This force can be supplied by a foot pump, or by air pressure, as in the ordinary fruit spraying devices. Sprinkling water in front of the fire reduces the force of the flames and permits close beating and raking. To be effective, considerable water is required when it is sprinkled directly on the flames. Water is used to the best advantage when the stream is thrown at the ground immediately in front of the flames. The water and force combined will stop the flames from advancing. It is also satisfactory to spray water against the base of the flames from the rear, particularly if there is much smoke.

Back-Firing.

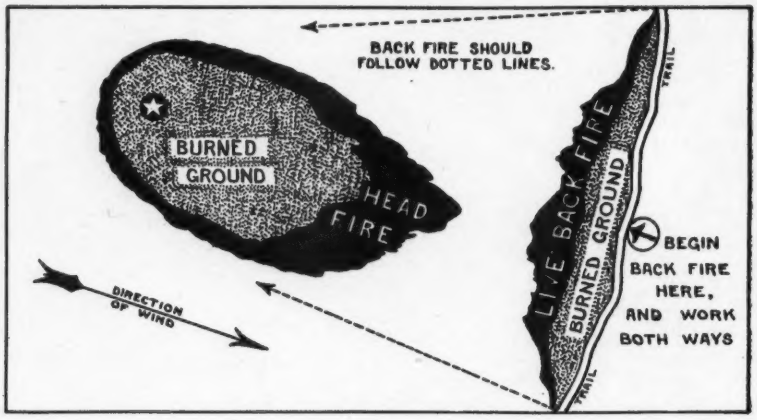
When the wind is strong or when the flames are in slash, fallen logs, dead ferns, bracken, or grass, fire becomes so intense that it is unsafe and impracticable to attempt close attack. Back-firing is resorted to in such



The incorrect way to attack by back-fire. The head-fire reaches the fire-break and jumps over it before the back-fire reaches the point of advantage.

cases. It should be remembered that fire is a dangerous force and that when fire is fought with fire extreme care and keen judgment must be used. If a fire starts some area will be burned-over and some growth will be damaged, but in order to reduce the damage as much as possible some additional sacrifice may have to be made by starting a back-fire. The area to be covered by the back-fire should, however, be kept as small as is practicable.

Frequently, under excitement, the speed at which the original fire is traveling is misjudged and a back-fire is started too close to it or too far in advance of it, usually the latter. Occasionally a back-fire has been set at the foot of a mountain along a road to stop a fire just coming over the top. Sometimes a land owner has set a back-fire along his property line without regard to where it may go or where the original fire was. Indiscriminate back-firing cannot be condemned too strongly. A lack of information regarding the locations of fire breaks already established and the topography may result in errors in back-firing. (Everyone should be on the watch for such cases and report them.) Such errors should be reported to the person in charge of the fire-fighting crews. After the necessity for starting a back-fire has been determined—and not before—the back-fire should be started as close to the main fire as practicable. Sometimes back-fires do not stop the original blaze. In that case the crew must drop back to a second line of defense and renew the attack. The retreat should be made promptly and the new fight started at once from the most advantageous position.

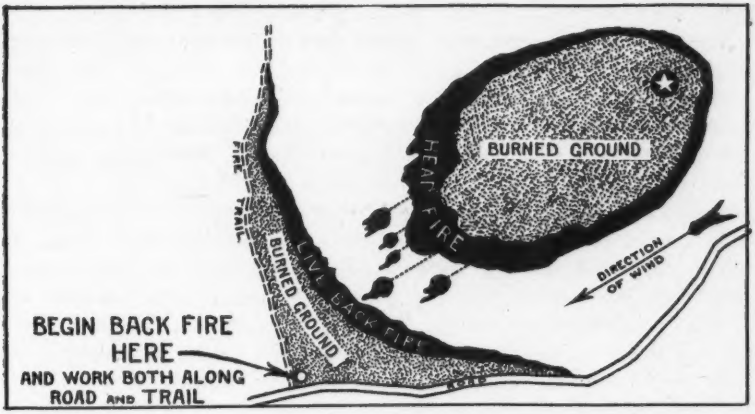


If worked straight across the head-fire, the back-fire must be long enough to check not only the narrow head-fire but also the full width of the fire behind.

Fire burns slowly down hill, and rapidly up hill. Therefore a good place to start a back-fire is just over the brow of a hill up which a fire is advancing on the opposite side. Fires burn slowly against the wind and rapidly with the wind. The heat and draft from the advancing fire attracts the heat from the back-fire and hastens the advance of the latter when the two are approaching. Observation of the force and direction of the wind will give warning in time to protect the men. It will also indicate whether a quick advance should be made to another point that is threatened by the flames.

A back-fire should be started from a fire-break, such as a road, stream, or other natural barrier. In case a fire-break is not found at the proper place for back-firing, one must be made. The ground should be cleared so that the damp mineral soil is exposed. Such a trail can be made very quickly, even through brush, with forked sticks if no other tools are available. Of course, axes, brush hooks, rakes, hoes, shovels, and brooms are better tools.

Usually the smoke is thickest, fighting is most uncomfortable, and danger of spark-spreading is greatest in line with the draft of the fire. The back-fire should be started at this point, and every man available is needed there. The back-fire should be started at the lower point of a V, the sides of which are open enough and extended far enough to include the header of the advancing fire. The whole crew is available to attack promptly the spot fires in case sparks cross the fire-break. As soon as the header is halted the side lines of the back-fire may be drawn in close to the side lines of the main fire and continued parallel to them, or even



Where an angle can be used a back-fire may have to be longer, but the area burned by the back-fire is reduced. Be careful that the side-fire does not come up before the wings of the back-fire are safe.

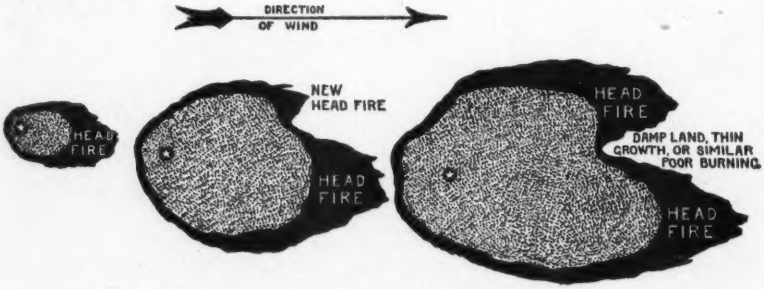
run into them. The rest of the fire-line may be beaten out. Remember, however, that a trail cleared to mineral soil should extend entirely around each fire to make it safe. The crew, even if small, should be divided at the point of the V, with a few more men on the side which should be advanced more rapidly or on which the danger is greater because of the wind.

A satisfactory arrangement of crews is as follows: The warden or foreman directs the course and location of the fire-break, if one must be made. He is in charge of the whole fire-fighting force and should urge each man to do his best. According to the amount of brush to be cut one or two axemen or brushcutters follow the warden. Four men with small wooden rakes, or some other tool, one working close to the other, make a clean trail, exposing the mineral soil, raking the material to the side away from the fire unless it is needed to start a back-fire. Next comes a man with a torch. He must not set fire too rapidly for the nearest raker, nor the guards who follow him. If the torchman sets fire too rapidly for the rakers the heat may drive them off their course, and if too rapidly for the guards, the fire may not burn away from the trail fast enough to permit their moving up with the torchman. As a result sparks may blow across the trail where there will be no one to discover and stamp them out immediately. Four alert and active guards can take care of a long line of back-fire. They should have three-gallon spray tanks and a continuous supply of water. They should have also a rake or broom. Pine brush may be used in the absence of a better tool. The rear guard must be the most dependable man in the crew for he must

determine when the line is safe and must not leave it until it is safe. It is important that someone who knows the woods after dark should be detailed to carry water.

Some authorities do not recommend a back-fire except as a last resort. There is no reason, however, why the principles of back-firing may not be used at every fire, no matter how small. Some persons recommend that a fire should be attacked where it is first met. This point, however, may be where it is doing the least damage. The essential point in forest protection is not merely to put a fire out, but to put it out in the shortest possible time, to restrict it to minimum area and damage. Therefore, it should be attacked where it is making most headway or where it is doing most damage. Some recommend attacking a fire on the side-line near the front. They contend the front is gradually narrowed and weakened until it is easily subdued by reducing the amount of fire and draft. There is some merit to this method, but it is a makeshift.

When fire runs into rocks, or burns over a very rocky area, it may be necessary to do considerable quarrying to establish a safety trail around the burned area. In such cases it may be necessary to start a back-fire at the outer edge of the rocks and let the fire smoulder under them. This should be done only after careful consideration of expense and damage.



How a side-fire may develop a new head-fire.

In rough hilly country several headers may develop because of topography. The size of the force available will determine how these headers should be handled. After one header has been subdued a change of wind may cause this situation to arise. It is always poor policy, therefore, to delay the attack on both side lines. As long as a flame burns, prompt and continuous action is required.

The foregoing illustration is described by a forester as follows: "It is useless to try to head off a fire ascending a steep slope. My method has been to start a back-fire at the top of the slope, dividing my men into two crews, each running a line away from the other, at right angles

to the direction of the oncoming fire until it is safe to run the line down the slope in the direction of the fire, flanking it and finally catching it in the rear." This is a satisfactory method of attack.

Occasionally a back-fire is started at the bottom and diagonally to the slope of a hill. As a result, usually the uphill draft causes the fire to move more rapidly than the men can handle it, and it sometimes gets away. If this method is necessary, the back-fire should be started at the top and worked down, running directly with the wind or at an angle to it. It pays to take the time to walk up a hill before starting the back-fire.

It is advisable to do some thinking after a fire has been extinguished. Review the plan of attack and consider whether better plans might have been made so that the fire could have been more quickly and more easily extinguished.

The Last Spark.

No fire is out until the last spark is dead. Sometimes warden and men leave as soon as the flames have been extinguished, with the result that frequently the fire has started up again at one or more places. Then the fire has to be fought again; it is larger, is harder to subdue, takes more time, costs more, burns over more area, and does more damage than the first fire. No chances should be taken with its breaking out a second time. All but the most dependable men should be discharged. The burned area should be inspected to see that there is no danger of fire creeping across the trail which ought to have been cleared around the burned area. Threatening brands should be thrown far into the burned area; logs and branches holding fire should be rolled over and sprinkled with water or covered with dirt until they are safe. Punky stumps should be examined and broken apart to see that they can give off no sparks. Burning snags standing within several hundred feet of the unburned area should be cut down. Every precaution should be taken to prevent a recurrence of the fire. If a fire has been put out during the day, the tract should be patrolled until the wind goes down in the evening, or until dew falls. If the fire has been extinguished in the morning and there is the least danger of its starting again, the area should be patrolled until the next afternoon or evening.

No fire is out until the last spark is dead.

Theatre Safety Curtains.

By Nolan D. Mitchell, Structural Engineer.
U. S. Bureau of Standards.

Theatre fires originate for the most part on the stage. Unless the proscenium opening is closed promptly in event of fire, flame and suffocating gas soon fill the auditorium. It is in this way that most of the major theatre fire disasters have occurred.

Fire-resistive curtains to isolate the stage from the auditorium are essential for life safety in case of fire. In addition there should be ample provision for ventilation above the stage so that smoke and hot gases will tend to rise through the vents rather than pass out into the auditorium. Automatic sprinklers or similar devices, while not so essential, are very desirable aids in controlling fire.

Inquiries from city authorities as to what the minimum building code requirements for proscenium curtains should be, led the Bureau of Standards to undertake an investigation of the subject. Examinations were made including operating tests of several installations of curtains of the rigid and flexible types. Afterwards fire tests were made on six curtain samples in the large panel furnace of the Bureau. Sections of two types of rigid steel curtains and four asbestos cloth curtains were tested. Two of the asbestos curtains were of the flexible type with pipe battens at top and bottom and standing cable side guides. One of these had two thicknesses of plain asbestos cloth and one had a single thickness of asbestos cloth with monel metal wire reinforcement. The other two asbestos curtains had two thicknesses of wire-reinforced asbestos-cloth stretched on steel frames with three inches space between, and were mounted on rigid side guides. The curtains, details of which are shown in Figures 1, 2 and 3, were tested on openings 14½ to 16 feet wide by 11 feet high, except curtain B, which was 9 feet wide by 6 feet high. The constructions of all were of such proportions and strength as would be used on proscenium openings of average size.

The measure of effectiveness of these curtains consists in their ability, (1) to withstand the pressures to which they will be subjected, (2) to operate effectively in emergencies to close the proscenium opening, (3) to prevent the passage of smoke and flame through or around the curtain, (4) to resist fire, and (5) to prevent glow or other fire effects from showing on the auditorium side when subjected to fire on the stage side.

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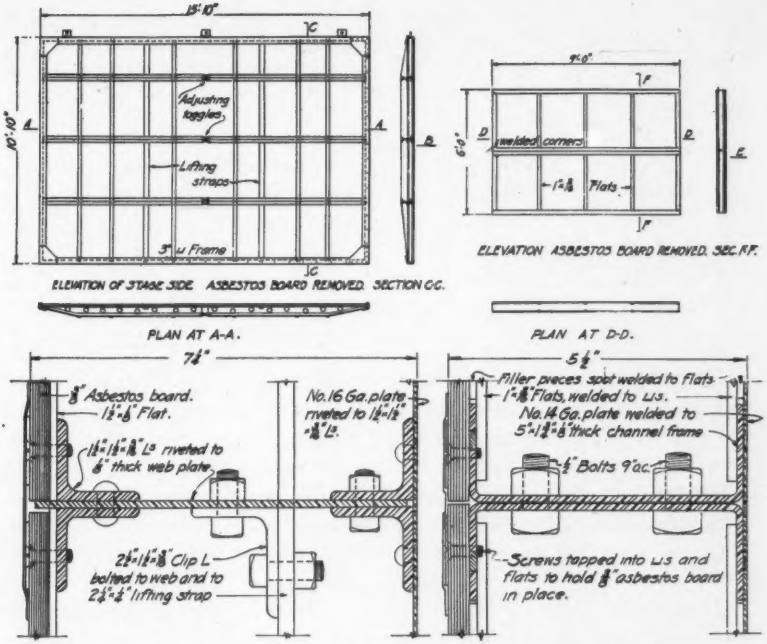

15'-10"
10'-10"
Adjusting toggles
Lifting straps
3" ⌀ Frame
ELEVATION OF STAGE SIDE. ASBESTOS BOARD REMOVED. SECTION C-C.
PLAN AT A-A.
9'-0"
6'-0"
welded corners
Flats
ELEVATION ASBESTOS BOARD REMOVED. SEC. F-F.
PLAN AT D-D.
7½"
⅜" Asbestos board.
1½"-⅜" Flat.
No. 16 Ga. plate riveted to 1½"-⅜"
2½"-1½"-⅜" Clip L bolted to web and to 2½"-¼" lifting strap
5½"
Filler pieces spot welded to flats
1"-⅜" Flats, welded to L's.
No. 14 Ga. plate welded to 5"-1½"-⅜" thick channel frame
½" Bolts 9" ac.
Screws tapped into L's and flats to hold ⅜" asbestos board in place.

a. DETAIL B. SECTION THROUGH GIRDER. *b.* DETAIL E. JUNCTION OF UNITS.

Figure 1. Details of steel test curtains.

The tests gave indications of the relative merits in respect to most of these functions.

Fire-Test Data of Theatre Curtains.

Curtain A. Seven and one-fourth inch thickness with steel face, ⅜ inch asbestos board back, channel frame with riveted horizontal girders.

Curtain B. Five and one-half inch thickness with steel face; sectional ⅜-inch asbestos board back, pressed channel girders, welded construction.

Curtain C. Double. Plain asbestos cloth, front and back, pipe battens, three 5/16 inch vertical cables between plies of cloth, spanning from batten to batten. Standing cable side guides.

Curtain D. Single asbestos cloth weighing 4.9 lbs. per sq. yd. with monel metal wire reinforcement in yarn. Pipe battens, three 5/16 inch vertical cables attached to edges and center at back of curtain. Standing cable side guides.

Curtain E. Double: asbestos cloth with monel metal wire on fire side, brass wire reinforced cloth on unexposed side. Rigid side guides with roller bearing trolleys. Rigid frame on sides and top, flexible bottom batten. Only marginal framework to keep plies of cloth separated.

Curtain F. Double: asbestos cloth with nickel wire reinforced cloth on fire side, 3 lb. brass wire reinforced cloth on unexposed side. Rigid side guides. Rigid frame of 3-inch channels with interior frame of pipes to provide positive separation of plies of cloth and reduce the span of the cloth.

TABLE I.

Curtain	Duration of Test	Average Temperatures at End of Test: FURNACE	SURFACE
A	30 minutes	1958° F.	527° F.
B	30	1816	394
C	15	1450	752
D	15	1629	1031
E	15	1600	804
F	15	1360	666

The lower surface temperature which obtained with curtain B compared with curtain A can be ascribed in part to the method of mounting the smaller curtain which permitted less heating of the edges. Both gave satisfactory performance as to protection against fires. Neither showed surface glow from the heating and only a slight smoking developed from the oil paint on the steel surface toward the end of an half-hour fire test. The indications were that both would afford protection to life and property for a somewhat longer time.

In several factors other than heat resistance curtains C and D gave unfavorable results. Curtain C was made of two sheets of plain asbestos cloth each weighing 2½ lbs. per sq. yd. and in many parts its strength was almost nil after the test. The sealing of the edges against the passage of smoke was poor, and the friction of the asbestos cloth against either brick walls or smooth steel slideways was very great when the curtain was subjected to even slight wind pressures. Curtain D, which was made single of an asbestos cloth weighing 4.9 lbs. per sq. yd. having monel metal wire insertion, had ample strength after the fire test (Fig. 4), but had all the other defects of Curtain C, and in addition showed glow on the surface sooner. The decorative paint on both curtains began burning early in the test and gave off dense black smoke.

Curtain E was made of two sheets of wire-reinforced asbestos-cloth mounted at the edges on each side of built up steel tees, set vertically, and having a transverse pipe batten at the top and a flexible batten at the bottom. Roller bearing trolleys at the sides held the tongue of the tee into the closed track forming an effectual smoke seal at the edges. The cloth on the side exposed to the fire had been used in the previous test and appeared to have sufficient strength to warrant its use in this test, but at about 7½ minutes a break about 30 inches long occurred just above the center and alongside of the vertical seam. This was probably

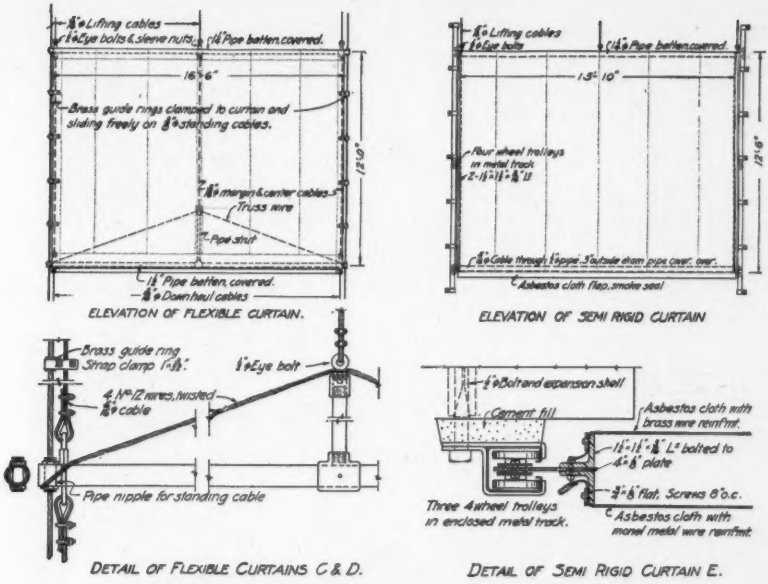

Brass guide rings clamped to curtain and sliding freely on standing cables.
Truss wire
Pipe stuff
Pipe batten, covered.
ELEVATION OF FLEXIBLE CURTAIN.
Four wheel trolleys in metal track
ELEVATION OF SEMI RIGID CURTAIN
Brass guide ring
Strap clamp
Eye bolt
Pipe nipple for standing cable
DETAIL OF FLEXIBLE CURTAINS C & D.
Bolt and expansion shell
Cement fill
Asbestos cloth with brass wire reinfmt.
Three 4 wheel trolleys in enclosed metal track.
Asbestos cloth with monel metal wire reinfmt.
DETAIL OF SEMI RIGID CURTAIN E.

Figure 2. Details of asbestos cloth curtains.

due to creases from handling the curtain after the first test, for strength tests after the second fire showed that this cloth which had monel metal wire insertion was stronger than the 3¼ lb. brass wire reinforced cloth which had been subjected only once to fire of the same intensity. The decorative paint, which was like that on curtains C and D, had one part of animal glue to nine parts water, and similarly began to give off dense black smoke at about two minutes. The general behavior was better than for the two previous tests.

Curtain F had its framework covered on the fire side with 3 pound asbestos cloth having nickel wires twisted into the yarn, on the other with cloth having brass wire. The paint had 4 parts casein to 10 parts of silicate of soda solution (spec. grav. 1.38) in 100 parts water to which were added 20 parts dry mineral pigment. Smoke started about as soon as the dense black smoke of the three previous tests, but was light and bluish and not so objectionable. No glow was visible on the face of the curtain for 12 minutes, and then only in a portion where the filling paint had not been brushed in well. The curtain did not have sufficient smoke seals along the top and bottom. In making installations these can be provided. The behavior of curtains E and F indicated that with few modifications they would give the required protection to audiences.

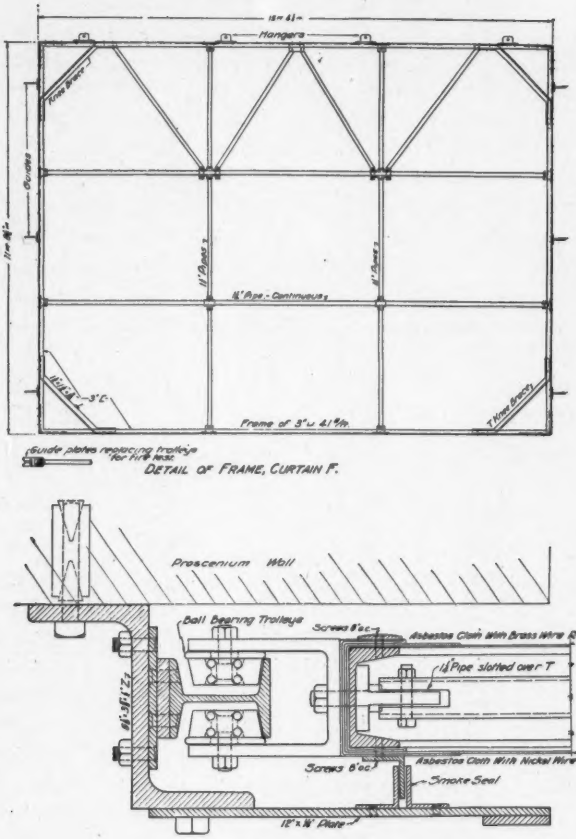


Figure 3. Details of rigid frame asbestos cloth curtains.

The examinations and tests disclosed weaknesses in some installations which lead to the conclusion that under conditions that might easily occur in any theatre they would be inadequate to secure even moderate protection. Studies of the subject, both in this country and Europe, have shown that the designing of fire curtains is a more serious problem than it appears to have been considered by some engaged in this kind of work.

The means for improvement of such existing installations are various, but the following suggestions will indicate what may be done in some cases. To prevent smoking and glowing an additional ply of asbestos cloth, having wire reinforcement inserted in the yarn, attached so as to

Figure 4. Curtain D under pressure test after fire.

secure a positive separation from the face curtain would be of considerable benefit. Decorative paints in which little or no organic matter is present will give less smoke. Horizontal members placed intermediate between the battens to transmit stresses to the side guides and reduce the span of the cloth to 8 feet will usually be sufficient to overcome the deficiency in the strength of the cloth. The top and bottom battens should be connected by rigid members to make them descend in unison and thus utilize the whole unbalanced weight to make the curtain descend to the floor and keep it in contact therewith. The friction should be reduced

to as low a factor as conditions will permit, preferably by the introduction of rigid side guides with anti-friction hangers or trolleys, otherwise by smooth metal slideways at the sides and top of the proscenium opening to prevent the curtain from bearing against the rough wall. Even with the latter improvement the coefficient of friction will be between one-half and unity, as was found when wind pressures were applied. Since the curtain should be operative when subjected to pressures up to five pounds per square foot of area the importance of reducing friction to a minimum will be seen. Probably the most practical way to make them operative is to adjust the counterweight so that the unbalanced weight of the curtain will exceed the total friction when the curtain is subjected to the pressure of 5 pounds per square foot. This in turn necessitates some means of regulating the speed of travel of the moving parts. In most cases the magnitude of the necessary unbalanced weight will require winches or power devices for hoisting the curtain.

Every curtain should have emergency closure controls operated manually from two or three points and automatically by quick-acting, heat operated devices placed in advantageous positions. The closure should be by gravity, and not depend on power operated devices. The emergency controls should be interconnected with the devices required to open large ventilators over the stage, so that this will be performed simultaneously with the closing of the curtain.

The curtain and curtain mounting should resist lateral pressures of 10 pounds per square foot of area of the curtain with a factor of safety of two on the ultimate strength. The maximum pressure will probably result from smoke and hot gases or from wind blowing through open doors and windows.

The time required for an audience to make orderly exit from most theatres will generally not exceed five minutes, but to provide a reasonable increase of time for emergency conditions the curtain should afford protection for a period of at least fifteen minutes. Well constructed double asbestos cloth curtains such as the better types tested will meet this requirement and afford considerable protection to the building. Rigid steel curtains of the two types tested will afford protection for one half hour or longer and in addition will give proportionately increased protection to the building.

This paper is a brief report of tests conducted at the Bureau of Standards as a part of the investigations of the fire-resisting properties of materials under the direction of Mr. S. H. Ingberg, physicist (member N. F. P. A.). A fuller account of them will be published as a Technologic Paper. Proscenium curtain specifications suitable for use in building codes have been prepared and are now available in Letter Circular 137 of the United States Bureau of Standards.

Pyroxylin Finishing Processes.

By E. Schuenemann, Chief Engineer.
Western Factory Insurance Association (Member N. F. P. A.)

Industries producing a highly finished product such as automobiles, furniture, and metal and wood specialties, are ever seeking ways and means for increasing the production, reducing costs and supplying a more attractive and dependable commodity. Nothing figures so largely in these problems as the final finishing of the product, for there, generally, the greatest time is consumed and expense incurred. The old methods of painting and varnishing, no matter how the materials were applied, were necessarily slow because of the nature of the materials, requiring long periods for oxidizing and generally the application of higher temperatures. It is therefore not surprising that new methods have been developed.

The use of pyroxylin base enamels appears to have produced the desired results. The introduction of these materials, entailing decidedly different methods of application and new industrial equipment, sometimes revolutionizes entire departments. It does not occur to the average manufacturer or property owner that he is also from a fire safety standpoint, radically changing the character of his plant by the introduction of these processes, which can under certain circumstances produce very severe hazards. Where these new processes are contemplated, the property owner should always consult competent fire protection engineering advice.

This article above shows how the Western Factory Insurance Association is coping with the unusual hazards incident to the use of pyroxylin finishes which are now being introduced in many industries. It represents a warning that is being given to the executives of plants where these hazards either exist or are likely to creep in. The article is not intended to furnish rules and regulations, or a plan of procedure where the installation of new apparatus is concerned, but as a guide to enable a manufacturer to analyze conditions in his own plant and to take immediate steps for safeguarding the hazards found.

It is urged that those in charge of plants where these processes are to be used should secure competent fire protection engineering advice, before proceeding with new installations. Such pyroxlyin finishing installation will be governed by the standard regulations of the National Fire Protection Association as promulgated by the National Board of Fire Underwriters. Such regulations are those on Dip Tanks, Spray Booths, etc., on Blower Systems and on Flammable Liquids. These regulations, now applying to the pyroxylin finishing hazards, will be amended in accordance with the dictates of the fast accumulating experience with these new processes.

This article is intended to prepare the ground for inspectors visiting plants where these processes are in use or are contemplated, and to aid in enlisting the co-operation of all concerned in the safeguarding of these new and important hazards.

The basic principles involved are not obscure or difficult to comprehend and as a rule the proper installation of the equipment is not any more expensive than hazardous and improper installation. A manufacturer can protect himself, safeguard the continuity of his business, and frequently secure better results, by being guided by the very wide and general experience of fire protection engineers.

These pyroxylin base enamels are now being produced and marketed by numerous manufacturers whose facilities and methods differ widely, and appear on the market under different trade names that do not indicate the character of the material or its properties. These new pyroxylin base finishing materials frequently called "lacquers" practically all have what is known as a nitro-cellulose (gun cotton) or pyroxylin base, with the admixture of minor ingredients to produce proper wearing qualities and the addition of coloring matter when necessary, all held in solution by highly volatile solvents. A wide difference in the character of basic materials and solvents is encountered in the field of the different lacquer manufacturers and their finished product may have widely different characteristics.

It is regrettable that representatives of some of the lacquer manufacturers in their attempt to introduce their individual product have minimized or denied the hazards attendant upon its use, instead of frankly admitting the hazards and pointing out the necessary safeguards which, when applied, would make the use of their material no more hazardous than the older methods of finishing.

These lacquers and their solvents, individually or mixed, ready for use, are highly flammable, but these raw materials unfortunately are not the hazard most to be feared. It is the consequential hazard due to their having been used that must be feared, more than the presence and immediate use of the materials.

The only successful application of pyroxylin base finishes thus far has been by the spraying or atomizing methods, with objects to be finished located in specially ventilated booths, hoods, tunnels or rooms. These spraying operations do not leave all of the solids on the object to be finished and much of the material passes off in the form of heavy vapor containing the solvents, coloring matter and nitro-cellulose. This waste material or residue is deposited on the interior of booths, vent pipes, vent stacks, and where ventilation is not perfect, spreads to floors, walls and ceilings and other contents of the rooms in which the spraying is done. This dried residue is highly flammable, at times easily ignited, and when once ignited gives off gases or vapors in the form of a heavy smoke which if not immediately burned but allowed to accumulate, has explosive properties. Fires that occur in areas used for spraying, and starting in

the residue from spraying operations, spread with lightning-like rapidity and the heat generated is usually sufficient to damage surroundings. In properties having automatic sprinkler protection, sprinkler heads open far beyond the area formerly involved in fires occurring under the old paint and varnish spraying operations.

It goes without saying that every manufacturer or property owner, if he realized the latent possibilities of these materials and operations, would take every possible precaution to prevent an interruption to his business. To this end new equipments should be installed with careful attention to the safeguarding of all fire hazards, and existing installations should be made to comply with the following recommendations.

Housekeeping.

Housekeeping should be above criticism and cleanliness should be superior if possible to that demanded in varnish and paint departments. Spray booths, including the space behind baffle plates, should be cleaned out daily. Vent pipes and stacks leading from spray booths should be cleaned out as often as deposits on the interior demand and if interior cannot be reached readily, proper cleanout doors should be provided. In cleaning booths, cleaning should be done with copper or brass spuds or with stiff fibre brushes. Waste materials scraped, brushed and swept out should be immersed in water in metal receptacles and removed from the premises. Sprinklers inside spray booths must be kept clean. If spraying is done in extra large booths or in tunnels or spray rooms, ventilating fans should be kept running during the noon hour and for thirty minutes after shutting down.

Equipment.

Equipment should be inspected and if any of the following weaknesses exist, they should be corrected:

If any booths now in use are of combustible construction their use should be prohibited at once. Nothing but incombustible booths should be tolerated.

Motors inside of spray booths should not be permitted; fans inside of booths are not desirable, but, if unavoidable, care should be taken that blades have plenty of clearance, are kept clean, and that the fan is driven by belt or extended shaft with motor outside of the stack or pipe.

Sprinkler heads should be installed in each booth.

No knife or snap switches for lights should be inside of the booths.

Lights should be in vapor-proof globes; or at a distance, using reflectors.

Stacks should be clear of all woodwork where passing through walls, roofs or floors, and should be treated the same as furnace stacks, for when fire occurs in spray booths, these stacks become red hot.

Stacks and vent pipes should be equipped with open (without fusible

links) sprinklers supplied from sprinkler system, but controlled by manually operated valves.

Roofs in the vicinity of the discharge points of vent stacks should be cleaned regularly as the collection of residue in these localities can easily produce conditions favorable to a bad fire.

Containers for pyroxylin enamels to feed spray guns by gravity must never be hung by combustible cords. Wire cables or metal rods are required.

Air supplied by fans for blowing out and exhausting booths should be drawn from outdoors, never from dust producing departments.

Exhaust pipes from booths must never discharge into other waste blowing pipes or ducts.

Exhaust pipes from spray booths should be individual and should not be manifolded into long horizontal pipes and thence into large stacks. Such grouping of booths and manifolding of pipes results in fire flashing from the point of origin to all of the booths and producing a conflagration condition.

A careful check-up of the existing equipment and its manner of operation is advised and if any of the above hazardous conditions or faulty equipment exist, a fire may be looked for at any time.

Operating Conditions.

Alternating the use of pyroxylin enamels with naphtha and oil base stains, ground coats, etc., is dangerous, for the alternating deposits of these two entirely different materials produces a dangerous residue in layers. Booths used for pyroxylin enamels should not be used for other purposes.

Rags, waste and other wiping material are dangerous if allowed to get past the fans and lodge in the vent pipes and stacks.

Stock should not be stored in front of or allowed to accumulate in front of and close to spray booth operations, as the first blast of fire is sure to ruin such stock, which in itself contributes to the fire.

Pressure containers for pyroxylin enamels should never contain more than a day's supply and air pressure should be released therefrom at night.

New Equipments.

The location of new departments involving pyroxylin base finishing operations should receive careful consideration. They should be segregated as much as possible and so located that fire and water damage occurring therein will not menace other departments. The design and arrangement of new equipments in such departments should be carefully planned and analyzed to see that none of the defects and hazards outlined above are incorporated.

Two Killed in Oil Barge Explosion.

An explosion, killing two men and injuring six others, occurred on an oil barge, containing 150,000 gallons of crude oil, at the municipal garbage disposal plant in southwest Philadelphia, on February 21.

As blazing oil drenched the vicinity and swept the surface of the Schuylkill River, a Baltimore & Ohio railroad train on the bridge raced to safety with a number of windows shattered by the concussion. Its passengers escaped injury. A shower of heavy steel fragments from the shattered barge pelted down on adjoining industrial plants as their employees rushed out of the buildings.

Fire apparatus, summoned by two alarms on the east bank of the river and three on the west bank, hurried to the scene in time to check the onrush of flames in the wake of the explosion, which threatened the railroad bridge. Spreading ashore at the disposal plant, the blaze damaged the pier and oil storage tanks.

Drifting patches of blazing fluid on the river's surface forced the crew of a pile driver to leap for their lives, while the intensity of the heat from the flames drove men off a number of barges moored nearby.

The men killed were the captain of the barge and a member of the crew of the oil company's tug which had towed the ill-fated barge to the plant. Their bodies went down with the shattered barge when its fire-swept hulk sank about an hour after the explosion. The cause of the explosion has not yet been ascertained.

Scobey Hospital Fire.

Fire swept the Scobey (private) Hospital at 906-908 Beacon Street, Boston, on Sunday afternoon, January 4, trapping 18 patients, two of them infants, and snuffing out the life of one woman before firemen and their ladders could reach the crowded windows to carry to safety the invalids, their nurses and some visitors trapped there, when a Christmas tree, suddenly set ablaze, transformed the interior of the hospital into a fiery furnace.

All of the 16 adult patients were "surgical cases" and all were confined to their beds. That more of them and their attendants and their visitors were not burned to death when fire cut off—in less than two minutes—all means of escape except the windows, was due to desperate rescue work by nurses, doctors, civilians and firemen.

Construction of the Building

The building had been made over for hospital purposes by taking two four-story residences and cutting two doorways through the fire wall that separated them. One opening was at the first floor and the other at the third. These openings had fire doors which were not automatic, and which were fastened open at the time of the fire. The lower one was closed after the fire began but the upper one, remaining open, permitted the fire to spread to the next building, causing the one loss of life and trapping the patients who were above the third floor.

The construction was ordinary brick with joisted frame interior and wooden unprotected stairways and a great deal of wooden trim, especially on the first floor. In accordance with municipal regulations the basements were sprinklered, but this protection did not extend to the rest of the building.

Story of the Fire.

The fire, starting just before one o'clock, when a flash from a supposed short-circuit ignited the lower limbs of a dismantled Christmas tree, swept the hospital clean. From street floor to roof the flames roared through every room with a rapidity that astounded eyewitnesses, racing upward through a circular wooden stairway that a few minutes after the first puff of flame was useless as a means of exit.

There were four women engaged in taking down the Christmas tree in the front room of the first floor when the fire started. They tried to smother it with rugs but the highly combustible tree, window curtains and wooden trim burned with amazing speed and swept up an unenclosed wooden stairway and into the adjoining building because the third floor

Courtesy Fire and Water Engineering.

Fire which started in a room near the foot of the stairs proceeded with astonishing rapidity up this unprotected stairway, making it impassable, and on through a fire door which was fastened open, snuffing out the life of a patient in the adjoining section of the building.

fire door had been fastened open. The single fatality was due to the spread of fire through this opening.

One of the women succeeded in getting the fire door on the first floor closed, while another, at the first flash, ran out to the fire alarm box, and a third put in an alarm by telephone shortly after attempts to smother the fire were unsuccessful. The woman who rushed out found the nearby alarm box and pulled in an alarm which was recorded at headquarters as

Courtesy Fire and Water Engineering.

Down these ladders civilians and firemen carried the helpless patients who were mostly "surgical cases." Those who were able to move crowded out on to the small balconies and endured the smoke pouring from the windows behind them until rescuers reached them.

of 12:51½ P. M. A bystander, who did not think she had properly pulled the box, sounded it again at 12:53. According to telephone company records a telephone alarm was received at 12:52 but was not recorded as having been received at fire headquarters. A district chief's driver pulled in a second alarm at 12:55½ which indicates that the department was on the scene promptly.

Life saving delayed fire-fighting operations. Hydrants nearest the hospital were frozen, and from four to ten minutes were lost in thawing them. The Suffolk County Grand Jury, in its report on the fire, charged the firemen with inefficiency. The fire had progressed to envelop the upper floors of the two buildings and there was much confusion while ladders were put up to the third and fourth floor windows. Civilians and firemen both engaged in the rescue work, and all the patients were removed except one woman who could not be reached because of the flames. The stairways were rendered useless by the fire and the patients had to be taken down the ladders. One of the patients was the daughter of Chief Sennott of the Boston Fire Department. Upon hearing of the location of the fire, he made a wild dash across the city.

The fire, and especially the Grand Jury findings, created something

of a furor in municipal circles in Boston. Chief Sennott and Mayor Curley strenuously denied the charges of inefficiency and also denied that there was a frozen hydrant to cause the delay. Because the bystander had pulled the box thinking the woman had not properly sounded the alarm the first time, a rumor was started that there was delay in sending in the alarm because of the old type of fire alarm boxes in use which necessitate pulling the hook in addition to opening the box door. This rumored fact was stressed by the newspapers and also by Mayor Curley and Chief Sennott, in spite of fire department records and the testimony of witnesses at two hearings—one held by the Grand Jury and the other by the State Fire Marshal—to the contrary.

All this talk detracted public notice from the real cause of the seriousness of the fire—the unsprinklered and combustible construction of the building, insufficiency of exits, and the fire door fastened open. The one loss of life was directly due to the open fire door on the third floor. The lack of exits imperiled the lives of the patients and made necessary the ladder rescues.

The character of the interior, highly combustible, without proper protection of vertical openings, and the total lack of first-aid fire appliances or a sprinkler system in the parts of the building affected, left nothing to retard the progress of the fire.

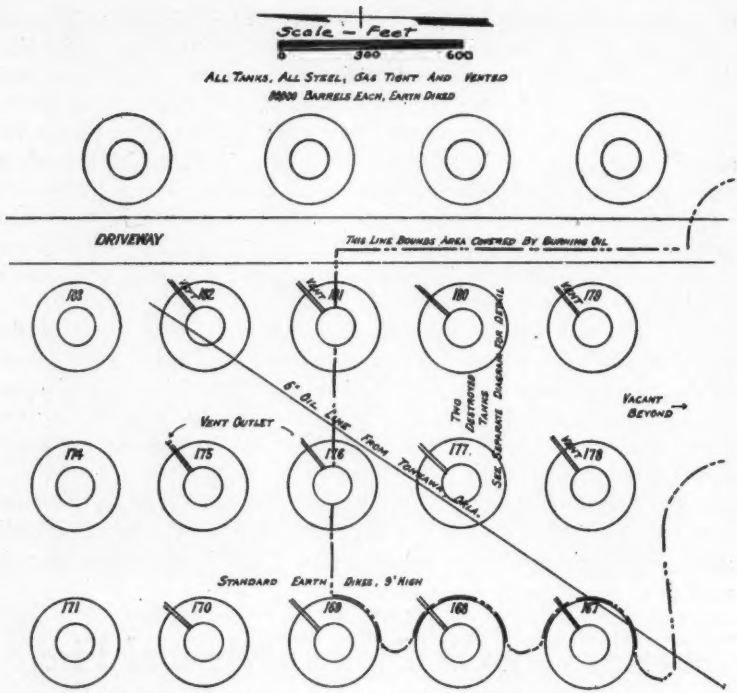
Ponca City Oil Tank Failure and Fire.

By H. W. Henry.
Oklahoma Inspection Bureau (Member N. F. P. A.)

On December 19, 1924, two 80,000-barrel steel oil tanks and their contents were destroyed on a large oil tank farm situated about 2½ miles southwest of Ponca City, Oklahoma. The fire started when, for some unexplained reason, one of the lower seams of one tank gave way, permitting the oil to flow out. Equally unexplained is the manner in which this became ignited. A second tank caught fire before the flames were under control.

The public fire department was not called as it was considered that the refinery employees responding to the summons, about 50 in number, could do as much unaided to prevent spread of fire as could have been done with aid of the public fire force. Their efforts were confined to controlling the direction of flow of the oil and the protection of piping, valve boxes, overhead wiring, etc.

Up to a time within 48 hours of the fire an unusually long period of remarkably mild autumn weather had prevailed. The mercury dropped within the two days just prior to the fire from 55 degrees above to 4 degrees below zero. The tanks contained fresh 38-40 Gr. crude petroleum



Map of the oil tank farm on which the fire occurred, showing tanks involved and extent of fire.

which was examined a day or two before the fire and found to be at a temperature of 60° F. The ground was entirely covered with a thin layer of ice due to a sleet storm which occurred just prior to the date of the fire. Employes who discovered the fire say that two or three distinct but rather muffled reports were heard at about 6:00 A. M. on December 19, causing the gauger, who was at the time serving also as watchman, and an employe in the field pump house to look out over the tank farm. Both men report that at first glance it seemed that at least six tanks were ablaze. The pump man immediately called the company central office by telephone and the operator there summoned all employes on the "fire list." The men began arriving at the tank farm within ten or fifteen minutes after being called.

As to the probable origin of the fire the theory which seems to merit most credence among the oil company officials is that due to climatic or other conditions one of the steel shell sheets in the first ring and on the north side of tank No. 177 (see diagram) crystallized, resulting at first in a small aperture in the shell near the ground level. It is thought that

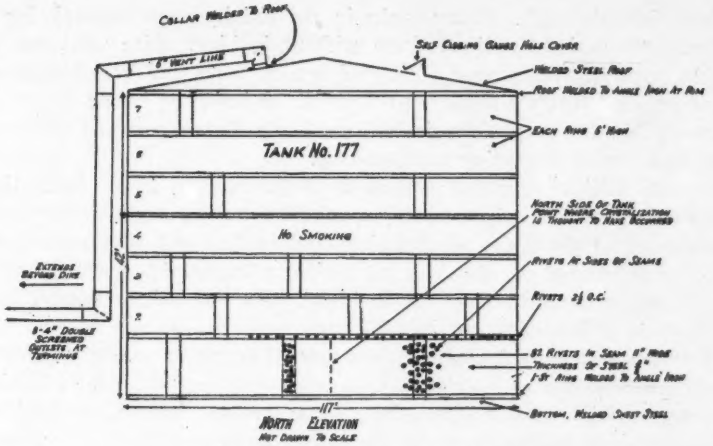

COLLAR WELDED TO ROOF
6" VENT LINE
SELF CLEARING GAUGE HOLE COVER
WELDED STEEL ROOF
ROOF WELDED TO ANGLE IRON AT RIM
EACH RING 6' HIGH
TANK No. 177
NORTH SIDE OF TANK POINT WHERE CRYSTALLIZATION IS THOUGHT TO HAVE OCCURRED
No SMOKING
EXTENDS BEYOND DIKE
RIVETS AT SIDES OF SEAMS
RIVETS 2½ O.C.
8-4" DOUBLE SCREENED OUTLETS AT TOPMINUS
BOTTOM, WELDED SHEET STEEL
NORTH ELEVATION
NOT DRAWN TO SCALE

Diagram of the tank which failed.

the widening of this opening occasioned by the sudden outrush of oil caused a partial collapse of the tank causing rivets to be sheared or other metallic friction which set up a static spark in the vapor-charged atmosphere in and immediately surrounding the tank.

The oil escaping from the north side of this tank quickly spread in all directions and almost instantly there was a flaming area entirely surrounding this and adjacent to the nearer of the exposing tanks in this portion of the field. The first outflow of oil being in one direction and of immense volume passed over the standard nine foot earthen dike and continued to and over some of the dike walls surrounding other tanks which were filled with high gravity crude oil with single exception of tank No. 180, situated 393 feet east of tank No. 177. Tank No. 180 contained oil to a height of 7 feet, 4 inches, or 14,098 barrels, giving rise to the belief that the shell offered less resistance than did the tanks which were entirely filled. It is also recognized that in this tank there was a much greater volume of gaseous vapor than in the other tanks just mentioned.

It is the expressed opinion of the refinery people that a seam in the shell of this second tank was ruptured from the outside by either the impact of the oil from the collapsed tank or by some object washed by the oil, permitting ingress of fire. Rupture is believed to have occurred within five or ten minutes after the collapse of the first tank. Considering the distance separating these tanks and the wide area of ground covered by the oil, this solution does not appear to be within the range of probability. It seems more likely that the tank was discharging vapor at some point in the shell or roof and that this vapor after igniting passed

flame into the tank. Other tanks in the vicinity were exposed for a protracted period to direct flame without igniting. Fire was seen to play on the screened vent outlets of several tanks and later inspection has revealed that the flame did not reach the inside or second screen of the pair in any case. This is held to clearly demonstrate the effectiveness of standard venting arrangements.

All officials, engineers and employes interviewed admit freely that the theory of fire origin, as here outlined, is wholly speculative. It is asserted that there was no lightning on that date and all are emphatic in the belief that the loss was not due to any defective welding or insufficient or improper riveting. It is maintained that there was no loud report to indicate any considerable explosion.

The shell of tank No. 177 was sheared from the welded steel bottom and was washed back (southward) to the dike wall. The roof fell in such a way as to almost entirely cover the tank bottom, the position of which remained unchanged. There was no large rent or other fissure in this roof to indicate that it had suffered an explosion, although the metal was burned to the appearance of "crust." There was, of course, no effort made to pump oil from this collapsed tank during the progress of the fire.

Tank No. 180, after the fire, was standing from one to three rings high, the upper shell having warped and crumbled inward. The roof fell inside the tank and bears no indication of an explosion. In the collapse of this tank, the shell sag was toward the south, at which time the first ring on the north side was forcibly pulled from the welded angle iron connection.

All tanks in this field were designed to withstand an internal pressure of more than twice that which obtained at the time of the fire. The contents (crude oil) of tank No. 177 is calculated to have exerted a pressure of 14.94 lbs. per square inch at the point where it is thought crystallization occurred. At the time the tank was accepted from the construction company, the oil people made tests considered necessary to assure themselves that the tank steel was of the required tensile strength. A shell plate from the first ring of tank No. 177 shows that it parted in a straight vertical line from top to bottom a considerable distance from any seam. A microscopic analysis of this particular piece of steel is now in process.

For the reasons just given, it is not thought material to embody in this report structural specifications followed in erecting the tank. The usual legion of "theories" has arisen in this case as is customary following any spectacular fire of considerable moment.

A Pyroxylin Lacquer Spray Booth Fire.

The Unit Construction Company of Philadelphia are manufacturers of wooden radio cabinets, to which a finish coat of pyroxylin-lacquer is applied by means of an air spray, in booths located in the third story of the main building. The booths are of metal, 8 feet wide, 7 feet high, and 7 feet deep, open at the front, similar to the one shown in the cut on the next page, although somewhat larger.

Soon after the noon hour on February 24, while the spraying process was stopped due to trouble with the exhaust fan, white vapors were seen arising from the floor inside one of the booths. Pails of sand were immediately applied, and the fire was apparently extinguished. Then suddenly the whole interior of the booth was ablaze, the flames bursting forth into the room and singeing the hair of one of the men. He escaped only by dropping on his hands and knees and crawling to the door. This flare from the booth was due to the deposit of pyroxylin-lacquer which had accumulated to a thickness of ¼ inch on the walls and one inch on the floor, and which, like all celluloid when decomposing, gives off two hundred times its own volume of flammable gases.

There were no sprinklers in the booth to check the fire, and in the few seconds before the sprinklers in the main room operated, the fire ignited newly finished cabinets nearby and spread to adjoining spray booths. These in turn poured out more burning gases, adding still further to the fire, which now gave off such intense heat that cabinets in the opposite end of the room were blistered and all of the 192 sprinklers in this area opened.

The employees quickly brought in two hose lines through the windows; and the fire department, which had been summoned, had three or four additional streams in action within about fifteen minutes.

The fire pump could not be started at once, as it should have been, because the steam pressure was low and there was no injector. The fireman began to raise the steam pressure, but when he found that the electrically driven feed pump could not be operated because the electric power had been cut off from the building by order of the fire department, he was obliged to bank the boiler fires.

The sprinklers kept the fire from spreading throughout the room, in spite of the fact that the 25,000-gallon sprinkler tank was probably exhausted before the fire department arrived, and the city water pressure

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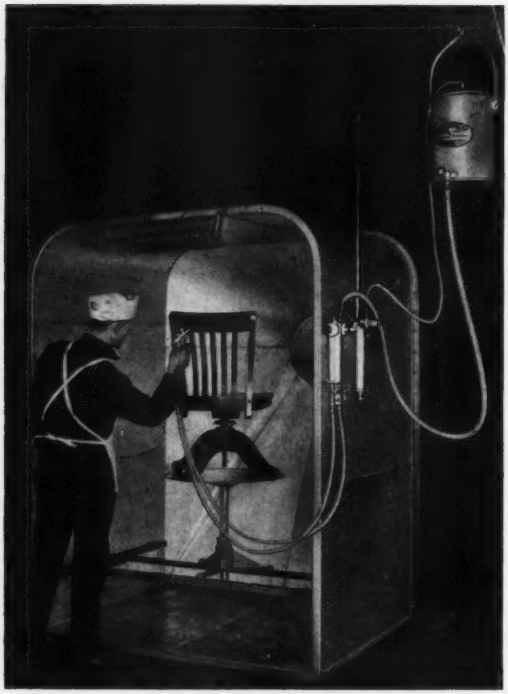
This article is reprinted from the *Factory Mutual Record*, published by the Inspection Department of the Associated Factory Mutual Fire Insurance Companies (Member N. F. P. A.).



A typical spray booth.

was lowered considerably by the large demand made upon it by the sprinklers and hose streams. As a result of the low water pressure, a hole was burned through the roof planking directly above the pile of burning cabinets in front of the booths. The sprinklers at this point were on the ends of the pipe lines, where the distribution of water would naturally be the poorest.

As soon as the fire was under control, the city water supply to the entire plant was shut off, instead of closing one valve which controlled the sprinklers in the building where the fire occurred. This condition was discovered a few hours later upon the arrival of our inspector, who had the protection immediately restored to all parts of the plant except the main mill, in which work was continued throughout the night until the sprinkler system was again in service.

The cause of the fire was evidently due to the spontaneous heating of waste or refuse on the floor of the booth, starting decomposition in the deposit of celluloid-lacquer, as evidenced by the white vapor which

was given off. The decomposition, when once started, developed rapidly, resulting in spontaneous ignition.

The loss will necessarily be heavy, probably reaching $120,000, because both the finished cabinets and the raw stock are very susceptible to water damage, and the entire building was wet down, due to floor leakage.

There are a number of other celluloid-lacquers besides "Duco" applied by an air spray and used as a finish, particularly on automobiles. The most important precautions to be followed when using these lacquers are the first three lessons of this fire as given below. In addition, the main supply of such lacquers and thinners should be kept outside of main buildings, and the spray booths should be amply ventilated by a fan having the motor outside the path of the fumes. All lights should be either in vapor-proof globes properly guarded against breakage or arranged outside the booth opposite windows. Switches and cut-outs should be outside of the spray room.

The lessons of this fire are as follows:

1. Detach or cut off spray booths, dip tanks, and similar hazardous processes from other valuable occupancies. If in an upper story, waterproof and drain the floor.
2. Provide sprinklers inside spray booths.
3. Maintain good housekeeping. Clean out spray booths daily.
4. Always maintain sufficient steam pressure for fire pumps and have an emergency boiler feed. Start pump immediately.
5. Have night and day force thoroughly familiar with the purpose of all sprinkler valves.

This experience also shows why the primary water supply to sprinklers should have good volume and pressure; and when from a tank, why a large one is needed. Low water pressure tends toward the opening of a large number of sprinklers rather than the confining of the fire to narrow limits, as is usually the case when sprinklers are supplied with ample water at strong pressure.

Grand Rapids Furniture Factory Fire.

Report by Western Factory Insurance Association.
(Member N. F. P. A.)

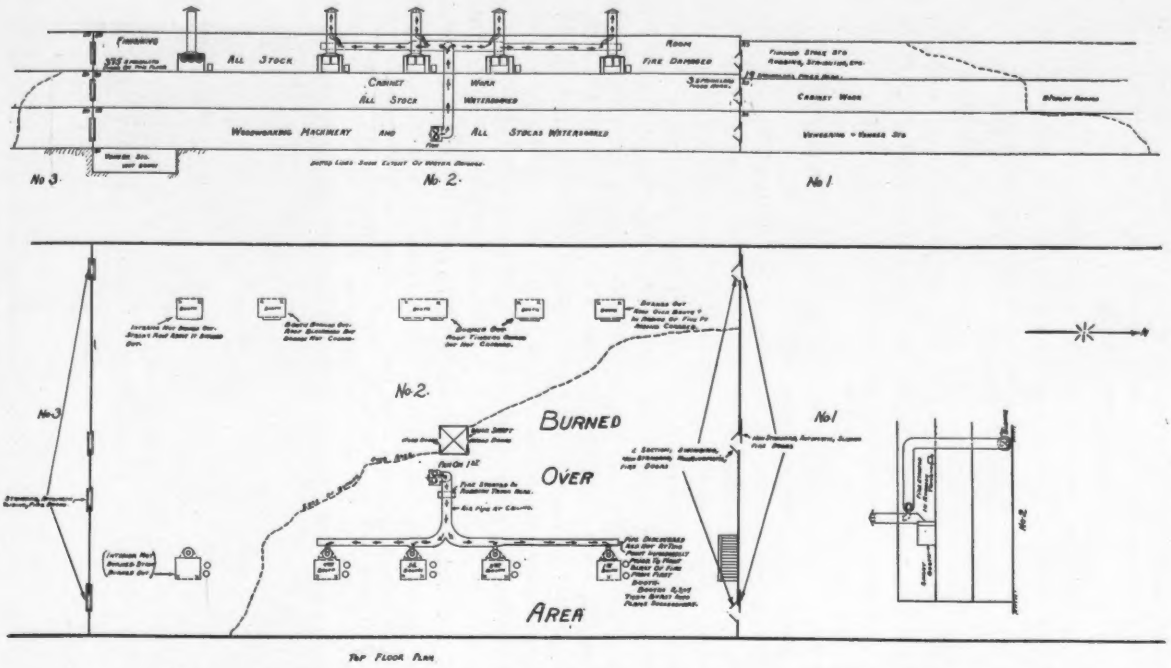
The fire occurred in a furniture factory, manufacturing dining and bedroom furniture and radio cabinets, on February 6, 1925, about 7:20 A. M., the plant being in operation. It started on the top floor of center section No. 2 (see diagram), in the spraying and finishing department, originating in a box of sweepings and waste materials from pyroxylin enamel spraying operations.

The building in which the fire occurred was of three stories and part basement; brick walls; the second floor of mill construction; third floor open joist, roof of light plank, semi-mill construction.

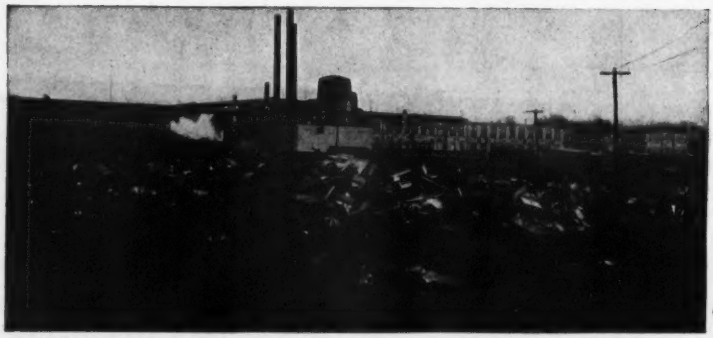
The fire alarm box on premises was pulled by an employe. Subsequent alarms for additional aid were telephoned by the fire marshal. No sprinkler alarms were in service. Sprinklers were prematurely shut off because the fire was thought to be out. The water had been off from two to four minutes when fire again broke out. Water supplies were overtaxed because of the large number of sprinkler heads which opened. Seven hose streams were required to control and extinguish the fire.

Occupancy and Fire Protection.

The building in which the fire occurred was occupied as follows: Partial basement filled with a large quantity of veneers. First story—woodworking machine room. Second story—cabinet work, sanding, gluing, large stock of furniture, all "in the white," awaiting finishing. Third story—finishing department and large stock of furniture in process, with various coats finished, mostly spraying operations. In the finishing department were ten spray booths (two independent batteries of four induced draft or syphon type ventilated booths; two, with inside fan and outside motor). The battery of four induced draft spray booths was principally involved in this fire, and was located along east or street side of the room. Air for ejecting dust, vapors and residues from spraying operations from these booths was supplied by a 70-inch fan located in the first story, on the woodworking machine floor, drawing air from that department, delivering it through a 24-inch galvanized iron riser pipe to a large manifold which in turn supplied air jets into each spray booth vent stack. The atmosphere in the first story naturally carries in suspension very fine particles of wood dust, and deposits of this fine dust were found inside the



Plan and elevation of section of factory involved in this fire. Dotted line on plan shows limits of burned area; dotted line in elevation shows extent of water damage. Duct piping shows how fire spread from one spray booth to next and also duct connection to the woodworking room.



View of the factory where the fire occurred. In the foreground is a pile of the cabinets in process which were so damaged by fire, and more particularly by water, that they were placed in this vacant lot and burned.

horizontal pipe and manifold connections of this fan. This dust furnished the secondary material for this fire.

Spraying operations using pyroxylin base enamels employed gravity receptacles hung from the ceiling by combustible cords, close to the booths, and 50 gallon steel drums under air pressure were placed in adjoining booths. It is said to have been the practice to clean out the residues in booths every Monday, but examination after the fire showed heavy deposits behind the removable baffle plates and in the stacks. A reserve supply of enamels in steel drums was located on this floor and quantities of freshly finished cases and furniture were scattered about the room.

The sprinklers on the top floor of Building 2 were supplied by three different risers. Two 5-inch risers fed by common 8-inch underground connection and controlled by a post indicator valve in the yard, supplied respectively 140 and 141 heads, with 19 heads in spray booths in addition. Each 5-inch riser had a dry valve without any gate valve. These dry valves were set wet. The third system with a 4-inch riser supplied 56 heads along south end of the room and was controlled by a separate post indicator valve in the yard. The total number of sprinkler heads opened was as follows:

3rd floor, Bldg. 2—356, including 19 in spray booths	
3rd floor, Bldg. 1— 19	
2nd floor, Bldg. 2— 3	
Total	378

Story of the Fire.

About 7:15 A. M., shortly after plant had started operations for the day, the janitor, who had finished cleaning on this floor and in and around spray booths, had placed sweepings and other waste materials,

which probably contained a large percentage of residue of pyroxylin base enamels, the result of spraying operations, in a wooden box on a factory truck. The janitor left it standing directly under a large metal overhead air blast pipe coming from the fan in the first story. The content of this box took fire, possibly spontaneously, immediately producing a fierce fire. Three sprinkler heads directly over this box fused and, aided by hand apparatus in the hands of employees, extinguished the fire.

The first alarm was turned in at 7:22 bringing the public fire department, who found fire practically extinguished. They placed temporary emergency plugs in the opened sprinkler heads to stop unnecessary water damage and spread sawdust on the floor to prevent leakage on goods below. Firemen also replaced fused sprinkler heads and ordered water turned into systems which had been shut off and drained when the fire was thought to be out.

The intense heat from the initial fire apparently ignited fine wood dust on the interior of the sheet metal air blast pipe where water from the sprinklers could not reach, and burned along the inside of this pipe unnoticed by anyone until a fireman noticed part of the metal air blast pipe was apparently red hot, indicating an internal fire. Before first aid appliances could be brought into play an explosion occurred in the north spray booth, on the street front, blowing a sheet of flame toward the windows and apparently blowing out some of the glass. Following this first explosion, at intervals of a few seconds, other puffs or mild explosions occurred in the next adjoining booths, all being interconnected by the sheet metal air blast pipe and manifold header in which the wood dust was burning. During this fire and the initial fire, the fan in the first floor was still running, which undoubtedly aided in blowing the fire to the various spray booths. Fire issuing from the booths found much flammable material to attack and feed upon, and traveled with great rapidity through the room.

In from two to four minutes water was again turned on the sprinkler system, but by this time the fire had flashed, opening, all told, 378 heads. Additional fire apparatus arrived, and in all nine hose lines were laid to the building and one engine connected to the sprinkler system. The fire was extinguished in about an hour.

The intensity of the fire and its rapid spread were materially aided by the falling of a number of three gallon gravity feed containers filled, or partly filled, with pyroxylin enamels, hung near the spray booths, spreading these burning materials over the floor.

Examination of premises, equipment and fire protection developed several interesting features. A considerable deposit of very fine wood dust was found in the horizontal runs of the air blast pipe, which furnished

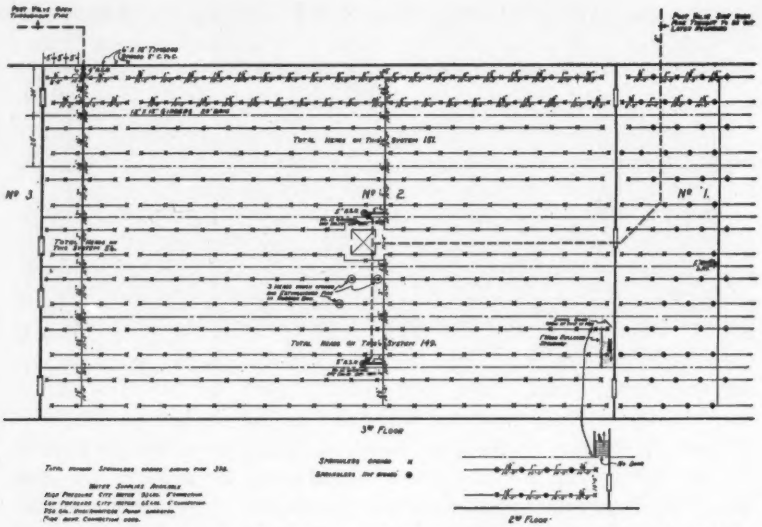


Diagram showing the large number of sprinklers opened by the flash fire, causing heavy water damage.

material for carrying the fire from the burning box of sweepings into the spray booths. A heavy deposit of burned out residue was found in the backs of the spray booths behind the baffle plates and in the stacks, indicating that a very hot and quick fire produced by the decomposition and burning of nitro-cellulose materials must have occurred here and probably produced the explosions in the early stages of the fire.

Conclusions.

While this loss may be ascribed to a combination of unfortunate circumstances there is no question but that its basic cause was faulty housekeeping and operations using pyroxylin base materials. The following conclusions and lessons taught thereby seem warranted.

1. The standard of housekeeping had not kept pace with the increase in hazard occasioned by the introduction or use of pyroxylin base finishing materials. Safeguards that were sufficient with the use of ordinary varnishes, paints, etc., were not adequate when these new materials were used. It seems certain that the cleaning of the booths, if carried out weekly as stated, was not thorough and was limited largely to the most accessible part of the booth, ignoring the accumulations behind the baffle plates, under the hoods and inside of the stacks.

2. The highly flammable character of sweepings and waste materials from the pyroxylin spraying operations when left in a dry state is again

proven. Had these materials been wet down, placed in closed metal receptacles, this loss would not have occurred.

3. This fire illustrates that spray booths should have individual vents, stacks, or exhaust pipes, that there should be no interconnection through the medium of a joint exhaust pipe or even a joint air blast pipe as was the case here. Common pipes, headers or manifolds carry the fire or explosions from one booth to another. Had it not been for the wood dust with possible admixture of spray residues in this air blast pipe and the fact that this pipe connected with four booths, fire would probably have been confined to one booth.

4. Where heavy loading, incrustations inside of booths, piping, stacks, etc., with pyroxylin waste materials occur, it is clear that the action of sprinklers is not quick enough to prevent explosions or flash fires due to the gases given off by the quick combustion of these materials.

5. The simple lesson that containers of flammable lacquers and kindred materials should not be hung by combustible cords is again demonstrated.

6. The feature which probably contributed to increasing this loss to the large proportion it assumed, is the fact that water was not turned on in the sprinklers when the serious stage of the fire came. The results prove again that when a fire opens such a large number of sprinklers this form of protection ceases to function as it is intended, and instead of confining the trouble and extinguishing the fire, merely serves to retard the fire in proportion to the volume of the water supply available.

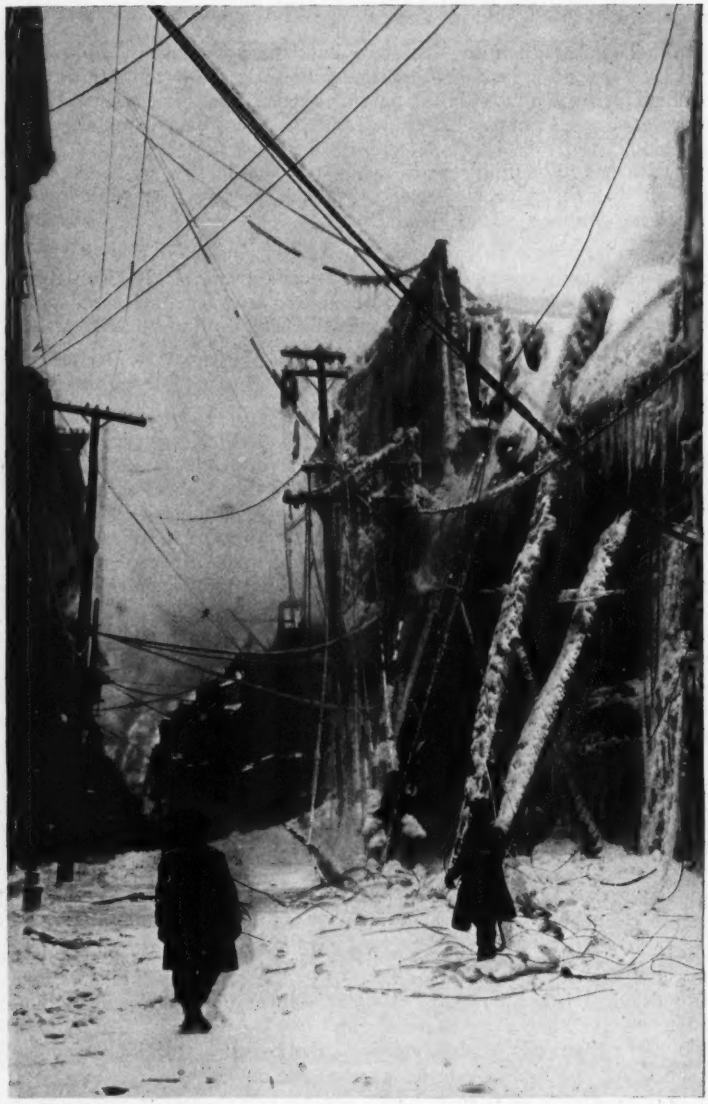
7. It would seem highly probable that had there been a series of draft curtains at the ceiling sub-dividing the ceiling areas, to inclose the different groups of spray booths, this fire might have been confined to the area over the spray booths along the east side of the room, preventing the opening of the sprinklers elsewhere and the subsequent overtaxing of the water supplies.

8. This fire also shows the menace of spraying operations to be in proportion to the combustibility and character of the stock surrounding these booths. Had this stock not been of such a flammable nature, the fire would probably have been more easily controlled.

9. The importance of standard automatic fire doors is clearly illustrated, for had the doors leading into Building 1 operated promptly, much water damage in this section could have been prevented.

10. To what extent the arrangement of the sprinkler mains, branch lines and spacing of the mains figured in the results obtained is not yet fully developed, but it seems reasonable to assume that even a modern system using approved arrangement and spacing would have accomplished little more than was accomplished by the existing sprinkler system due to the water supplies being overtaxed at the outset.

11. Where trunk line exhaust systems and manifold connections are unavoidable, open sprinklers manually controlled, located inside of such piping should always be installed.



The building where the first fire started is at the right. Smoke filtered into the adjacent building causing an explosion in the upper story. The picture shows graphically the havoc wrought by fire, water and weather.

Three Simultaneous Fires in Montreal.

By C. L. Scofield.
(Member N. F. P. A.)

Experience has well established that the two greatest menaces to the sprinklered property are the closed valve and the unsprinklered exposure. Illustrating the latter cause and containing some unusual features was the result of fires that occurred almost simultaneously in three separate buildings in close proximity in the downtown or inner conflagration district of Montreal on the evening of January 28, 1925. Local conditions, including the severity of the weather at the time, undoubtedly added to the extent of the damage, for two of the fires developed such proportions as to involve adjoining buildings, both sprinklered and unsprinklered, while the third was confined with comparatively small loss to the place of origin.

The Story of the Fire.

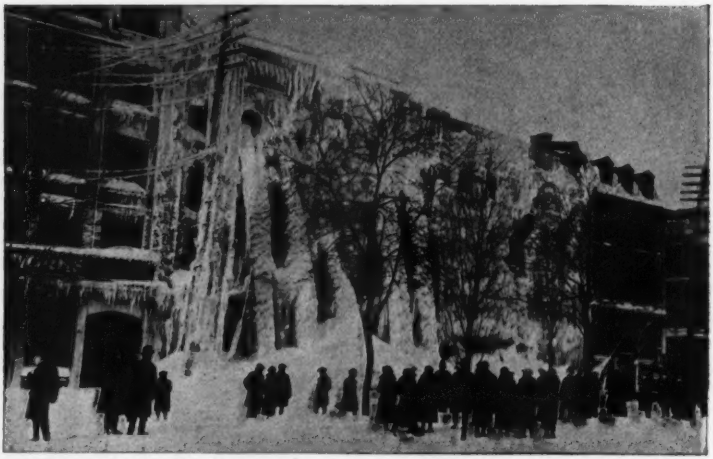
The causes of the fires are not yet known, but the fire in the unsprinklered building at 450-458 St. Paul Street had a good start before discovery. Smoke evidently filtered into the upper story of the next building and an explosion followed which added to the spread of the fire. A second fire less than a block away was discovered and a general alarm was sounded. A third fire, two blocks west, was extinguished before it had much of a start.

The fire station was only 150 feet away, as the diagram shows, but fire-fighting operations were limited by the intense cold which made the water freeze as fast as it was thrown.

A fire lieutenant was trapped by falling floors in an unsprinklered building and could not be released for over seven hours. In addition to other injuries, he was badly frozen from the exposure and died three days later in the hospital.

Buildings Involved.

These three fires had no connection with one another, but were all within a small area as indicated on the accompanying diagram. With the exception of a wide open square at Place D'Youville, practically all of the streets in the neighborhood are narrow, averaging 30 feet in width. This being an old part of the city, many of the buildings are of considerable age, of moderate area, stone or brick walls with a very small percentage of frame in the upper stories: of ordinary joist construction, mainly hollow finish. Division is by party walls only and many of them are light. There are three modern office buildings of fire-resistive construction and



The ice-laden buildings facing on the Place D'Youville. Fire-fighting equipment is buried beneath the snow and ice.

one six-story sprinklered building of good plank and timber construction. The occupancies are mainly mercantile or light manufacturing and chiefly furriers or wholesale leather.

There are thirty-three sprinklered properties within the area indicated, two of them out of service, the buildings being vacant and unheated. Nineteen of the equipments have city supply only—seven with only one connection—while fourteen have gravity tanks in addition to the city water. The normal static city pressure is seventy-five pounds and there being a good gridiron system with ample feeders, the pressure was well maintained during the fires notwithstanding the heavy draft. The nearest fire station is within 150 feet of where the first fire started as shown on the diagram.

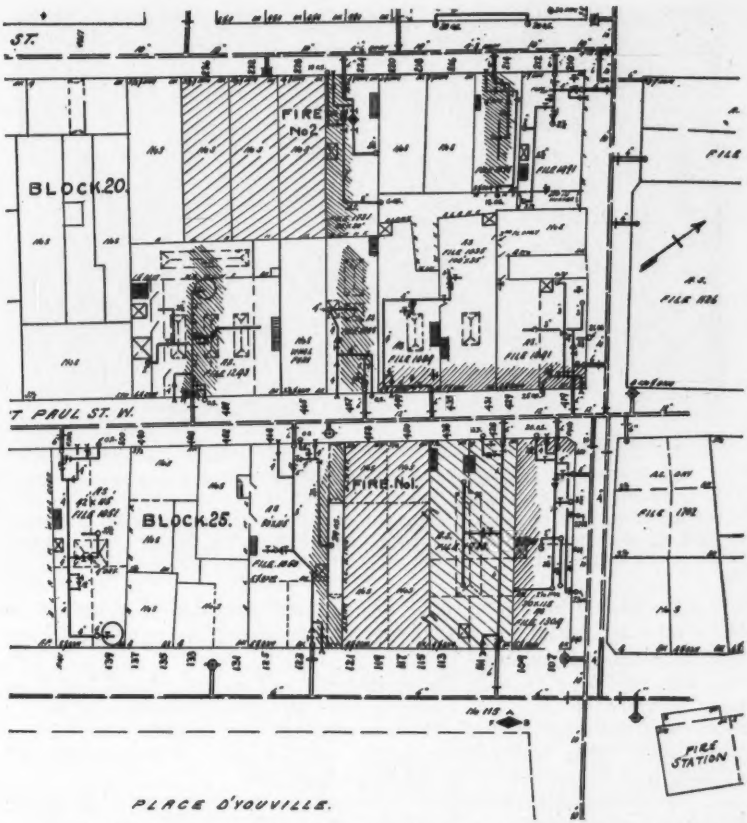
There was only a slight wind on the night of the fire but the temperature ranged from 8.5 to 10 or more degrees below zero F.

Losses in the sprinklered properties will be about 13% of valuation and about 16% of the value of the contents. In the non-sprinklered buildings the losses ran up to probably 75%. Aggregate losses in these fires will be around $500,000. The fires occurred between seasons in the fur trade, or the losses would probably have been greater.

Unusual Features of the Fires.

The principal unusual features, aside from the three separate fires starting almost simultaneously, were:—

(*a*) The explosion on the top floor of the building at 450-458 St. Paul Street, which explosion involved also the top floor of the sprinklered



Plan of the area involved in fires Nos. 1 and 2. Fire No. 3 is not shown, but occurred in a building two blocks west of the diagram. Complete crosshatching indicates buildings which were completely destroyed or badly damaged; the short crosshatching indicates the buildings affected by fire, explosion, or water.

section No. 428 St. Paul Street through to No. 109-111 Place D'Youville. This explosion wrecked the roof and ruptured the sprinkler pipes prior to the operation of the sprinkler heads so far as can be determined from the fact that alarm valve did not operate and sprinkler lines were seen with heads intact. There were 102 sprinklers on the top floor supplied by two four-inch risers. The party wall between the unsprinklered building at No. 450-458 St. Paul Street, where the first fire started, and the sprinklered section at 450 St. Paul Street was only 8 to 12 inches thick on the top floors and it is thought that the heavy smoke from the fire in the unsprinklered building entered through the cracks at the fire doors

Close view showing the ice burdens on buildings and apparatus. The large amount of water in the basement prevented the immediate closing of the inside sprinkler valves and the street valves were inaccessible for two days till they were reached through seven feet of ice, during which time the water continued to discharge through the broken sprinkler pipes.

and accumulated in the top floor of the sprinklered building, and there being no vent, resulted in a smoke explosion when the fire entered from the unsprinklered building.

The top floor of both the sprinklered and unsprinklered buildings were occupied by the same tenant, a loose leaf manufacturer, and so far as shown there was nothing in the occupancy to have caused such a violent explosion. There was no fire below the top floor of the sprinklered building and no sprinklers opened below that floor.

The building was soaked with water from hose streams and from the broken sprinkler pipes.

(*b*) The effect of the explosion on other sprinklered buildings in the vicinity, resulted in broken windows, making it necessary to shut off and drain the sprinkler equipment in the adjoining building at the west, No. 420 St. Paul Street, to prevent its being frozen, and minor damage, through broken windows to other sprinklered properties, the frost affecting both heating systems and sprinkler pipes.

(*c*) The large amount of slush and water in the streets flooding basements, thus putting out of service heating systems and damaging stocks in properties not directly affected by the fire.

(*d*) The large amount of water in the basement of No. 428 St. Paul Street prevented the immediate closing of the inside sprinkler controlling valves, and as the street valves were inaccessible, due to the heavy accumulation of ice, the water continued to discharge from the broken sprinkler pipes for two days, before the inside valves were reached. Later the city valves were uncovered through seven feet of ice and closed.

Firemen digging out a ladder truck the day after the fire.

The most interesting feature, the cause for which has not been determined, was the explosion which wrecked the top floor of the sprinklered building between St. Paul Street and the Place D'Youville and the unsprinklered building adjoining and communicating where the first fire started. There was a minor smoke explosion in the building at No. 224 Lemoine Street, adjoining the unsprinklered building where the second fire started. No sprinklers opened in this building.

AUTHOR'S NOTE: This report has been written principally from details furnished by Inspector D. C. Winsor of the Sprinklered Risk Department, who responded to the first fire, reported the second fire to the Fire Department and was on the ground all night. Mr. H. Rethoret, Manager of the Loss and Investigation Department, Mr. James Leslie, Water Works Engineer, and Mr. W. J. McCarthy, Chief Inspector of the Sprinklered Risk Department, were also on the ground for the greater part of the night.

A Radio Battery Fire.

By H. W. Goodrich, Electrical Inspector.
Iowa Insurance Service Bureau (Member N. F. P. A.).

With the increasing number of radio sets in use this fire in a Des Moines residence is of particular interest.

In the basement was a wooden shelf on which was placed a large-sized storage "A" battery and a battery charger of the vibrator type. The charger was connected to the house lighting circuit and was protected by its branch fuse. Fuse protection was also built into the charger on the low voltage side and this circuit was carried to one side of a double pole double throw switch also on the floor above. Leads from the radio apparatus were connected to the other side of the above switch. The storage battery leads were connected to the neutral switch points and so far as can be ascertained consisted of stranded wire, one lead with asbestos and braided covering, the other of rubber. The leads in going to their switch position were run in loose contact with a hot water pipe of the heating system.

The apparatus was last observed before the fire about 11:00 P. M. and the rectifier was charging the battery in a satisfactory manner. The fire was discovered about 2:00 A. M. and had become so severe that the occupants were forced to leave the building by ladders from a porch roof.

It is probable that the fire started from the short circuiting of the battery leads at the point where they were against the hot water pipe. The apparatus had been installed about one year and the pipe, when the investigation was made, was too hot for the hand to remain more than a short time. This condition having been existant for some time the insulation on the battery leads probably deteriorated gradually until the short circuit point was reached.

The progress of the fire was through the floor and up through the space between the wall studding which contained heating pipes. On the first floor the flames spread extensively and traveled upward through the space between the wall studding to the second floor level where they were stopped by the fire-stopping used in the building construction. Damage done will probably amount to about $20,000.

This fire emphasizes the fact that particular care must be given to the installation of the leads from the storage "A" battery and that fuse protection for them is desirable.

Fires in Which There Was Loss of Life.

These notes are intended to point out typical conditions under which loss of life has occurred, that they may be known and guarded against.

Alcohol and Turpentine.

H-21681. PITTSBURGH, PA., FEBRUARY 6, 1925. One employee met death and thirty firemen were overcome by fumes while fighting a fire in the sub-basement of a hotel. The fire started from an explosion of a quantity of alcohol and turpentine in a sub-basement storage room. When firemen attempted to enter the room they fell back, many of them shrieking and delirious. The whole sixteenth floor of the hotel was converted into an emergency hospital and physicians and nurses called in from hospitals to attend the firemen, who were seized with violent convulsions in the underground room. A number of firemen were overcome in attempting to rescue two employees of the hotel from the fume-ridden room.

Wood Alcohol.

H-21551. TORONTO, CANADA, OCTOBER 10, 1924. A woman was in the basement of her home using a quantity of wood alcohol and other spirits when the liquid exploded and ignited her clothing. A neighbor saw smoke arising from the cellar window and with two other men rushed into the house and found the woman lying on the floor with her clothes ablaze. They extinguished the fire and the woman was rushed to the hospital where she died from her burns.

Gasoline.

S-38922. TRENTON, N. J., NOVEMBER 17, 1924. The building in which fire started was used for manufacturing automobile tires and tubes. The tire maker had used gasoline to soften rubber cement when putting a tread on the tire. A flannel rag ignited due to friction caused in rubbing it on the tire. At the sight of fire the workman evidently became confused and spilled gasoline on his clothing. His clothes were burned from his body. He died in the hospital two days later.

H-21584. CALDWELL, N. J., JANUARY 12, 1925. Two women and five children were burned to death when fire destroyed a two-family house in the woods near here. Three men escaped by jumping from the windows, but one was very badly burned. The fire started from an explosion of gasoline which was being used by one of the women to start the kitchen fire. She escaped from the house but returned to rescue her nine months' old son and her escape was cut off.

Kerosene.

H-21568. READING, MASS., DECEMBER 22, 1924. A woman, who was alone in the house, found her kitchen so cold that she started to use some kerosene to hasten the fire. Just as she tilted the can on to the fire there was an explosion and her clothes burst into flames. She ran screaming out into the street. A man who was passing extinguished the flames and the woman was taken to the hospital where it was found that she had been fatally burned about the body.

Kerosene Stove.

H-21680. ROXBURY, MASS., JANUARY 24, 1925. An oil stove used to heat an apartment which was occupied by an aged woman and her daughter exploded and the flames ignited the mattress and coverings of the bed in which they were both sleeping. The force of the explosion overturned another oil stove that had been placed close to the bed, causing a thick volume of ill-smelling smoke to fill the house. The daughter, aroused by the suffocating fumes, braved the flames and assisted her mother from the blazing bed. Both the mother and daughter were taken to the hospital. The mother died soon after her arrival and the daughter the next day.

Oil Refinery.

H-21679. HEATH, OHIO, FEBRUARY 4, 1925. The plant was a crude petroleum refinery doing only skimming and cracking. At midnight two men commenced their work of cleaning out a reaction chamber for one of the cracking stills which had been shut down since 8 A. M. the same day. The balance of the plant was being operated at the normal capacity. A man in the control house and other employees saw the flash caused by contact of escaping gas and the flame under the still. The employee had opened three valves beneath the reaction chamber that was in service instead of the three valves on the device that had been idle since morning. The last valve he opened released to the air gasoline vapor under 600 pounds pressure, which caused the gas to whip down towards the flames in the fire box of the still in service and instantly flash, killing his fellow workman and burning himself so severely that he died the next morning.

Hotel.

H-21683. GLOUCESTER, MASS., FEBRUARY 23, 1925. Fire of undetermined origin practically destroyed the block in which the Belmont Hotel was located. That all of the occupants of the hotel did not perish is believed to have been due to the quick work of three policemen who rushed through the hostelry and aroused the occupants. In the excitement one room was overlooked and the occupant was trapped in his room and perished. Ladders were run up to the window in an attempt to rescue

him and just as two firemen were within reach of the window a large plate glass window in the store on the ground floor was blown out and flame began attacking the base of the ladders. Firemen were forced to abandon their attempt to rescue the man. Ten days later the body of another man, who was not missed at the time of the fire, was found in the ruins. Two firemen were injured, one was cut by falling glass and the other was struck by a squirming piece of hose that escaped from the hands of his comrades.

Overheated Stove.

H-21686. WORCESTER, MASS., FEBRUARY 4, 1925. Fire, which started from an overheated stove, caused the death of two children. The mother was near death also as a result of her efforts to save them. The two-year-old son was burned to death in his crib, while the nine months' old daughter died at the hospital from burns and injuries. The mother carried both children from the burning building but collapsed herself without knowing that her children's lives had been forfeited to the flames. A third child who was also carried out by the mother was badly burned.

Falling Wall.

H-21467. PITTSBURGH, PA., OCTOBER 9, 1924. Fire started at a feather crusher in a plant used for manufacturing feather cushions and pillows. The feather crusher was not cut off and the balance of the building was all one fire area of light joisted construction with unprotected floor openings. The fire had a very good start and the building was well adapted for its rapid spread. One fireman was killed and four severely injured when they were pinned under the wreckage of a falling wall.

Brick Apartment.

H-21682. BROOKLYN, N. Y., MARCH 3, 1925. The bodies of a mother and her two children were found in the ruins of a brick apartment house. They were in bed and had evidently been suffocated by smoke. Another woman was burned so severely that she died from her burns. A mother threw her six-year-old son from a window on the third floor and the child's arm and leg were broken. Several other persons, including six firemen, were hurt or overcome by smoke.

Annual Summary.

Statistics of Fires in Properties Having Automatic Sprinkler Protection.

NOTE.—These tabulations are made at the close of each year with the object of furnishing a basis upon which the virtues of the automatic sprinkler as an extinguishing agent can be estimated.

Secton I is devoted to fires in which the behavior of sprinklers was, for the reasons given, unsatisfactory.

Section II is a statistical record of all reports of sprinkler fires in the files of the Association upon which the information obtained is sufficiently complete for statistical purposes.

In each table the results of the current year ending February 1, 1925, are given, and these are compared with the results of the total twenty-nine year record ending at that time.

The sprinkler tabulation has been shortened this year by the omission of several of the relatively unimportant tables, this decision having been reached by the Committee on Fire Record after careful study of the entire tabulation. Experience has shown that the few tables dropped are not changed appreciably from year to year by the results of new fires reported. For such data the tables published in the April, 1923, QUARTERLY may be consulted. (Vol. 17, No. 4 p. 401.)

For the convenience of those who desire to compare the extent of the current tabulations with the similar tables appearing in previous volumes of the QUARTERLY, the following comparison is given:

Name of Table	1923 Tables	1924 Tables	Remarks
Unsatisfactory Sprinkler Fires	Section I	Section I	No change
Annual Revision of Sprinkler Tables			
Time of Day	Table No. 1		Omitted
How Discovered	Table No. 2		Omitted
Efficiency of Alarm Service	Table No. 3		Omitted
Number of Sprinklers Operating	Table No. 4	Table No. 1	No change
	Table No. 5	Table No. 2	No change
Effect of Sprinklers	Table No. 6	Table No. 3	Less detail
Primary Water Supplies	Table No. 7		Omitted
Effect of Sprinklers, by Occupancy	Table No. 8	Table No. 4	No change
Unsatisfactory Sprinkler Fires, by Occupancy	Table No. 9	Table No. 5	No change
Secondary Water Supplies	Table No. 10		Omitted
	Table No. 11		Omitted
Efficiency of Primary Supply	Section III		Omitted

The total number of sprinklered fire reports received during the past year is 2227. The number of fires in which the sprinklers were not a factor* or which were discovered and extinguished before there was sufficient heat to open the sprinklers was 461.

*By "not a factor" is meant fires that occur in unsprinklered portions of a building.

The number of fires in which sprinklers operated is 1766 as compared with 2198 last year. The number of failures for the two years are respectively 65 and 98, making the percent of satisfactory operation 96.3 and 95.5. The tables on Number of Sprinklers Operating show that 78.1 per cent. of the fires during the year were extinguished with five or less heads operating.

SECTION I.

Summary of Unsatisfactory Sprinkler Fires.

	1924-1925		1897-1925, incl.	
	No. of Fires	Per Cent	No. of Fires	Per Cent
Water shut off sprinklers	22	33.9	410	29.4
Generally defective equipment	4	6.2	276	19.8
Unsprinklered portions	5	7.7		
Defective water supply or supplies	6	9.2	124	9.6
Sprinkler system crippled due to freezing	..	..	42	3.1
Slow operation of dry system or defective valve	1	1.5	37	2.6
Slow or defective operation of high test heads	1	1.5	24	1.6
Faulty building construction, concealed spaces, vertical openings, etc.	3	4.6	71	5.1
Obstruction to distribution	2	3.1	80	5.7
Hazard of occupancy too severe for average sprinkler equipment	8	12.3	83	6.0
Explosion crippled sprinkler system	2	3.1	60	4.1
Exposure or conflagration	..	..	72	5.1
Plugged heads (included with Miscellaneous prior to 1921)	..	..	11	.8
Miscellaneous	11	16.9	100	7.1
Total	65		1390	

Special Classification of Fires in Which Failure Was Due to Water Being Shut Off Sprinklers.

	1924-1925 No. of Fires	1897-1925 No. of Fires
Water shut off for unknown reason, neglect or carelessness	7	148
Water shut off before fire was out or fire rekindled	5	64
Water shut off due to accidents or repairs	6	67
Water shut off to prevent freezing	2	86
Water shut off, probably incendiary	..	6
Water shut off, leaky dry system	..	11
Water shut off, miscellaneous	2	21
Water shut off, defective gate valve	..	7
Total	22	410

SECTION II.

Annual Revision of Sprinkler Fire Tables.

In the following tables is given a summary of fires occurring in properties equipped with automatic sprinklers. The total number of such fires reported during the past year is 2227, which includes 461 fires where no sprinklers were opened. Several reports were also received in which the data was incomplete, and these were not used in the summary. It may be noted that the total number of fires does not agree throughout all the tables. This is because some of the reports of fires prior to 1909 were not considered sufficiently complete to include in all the tables, and hence appear in some tables, but not in others.

Table No. 1—Number of Sprinklers Operating.

No. of Fires, 1924-1925

No. of Sprinklers Operating	Wet	%	Dry	%	No Data	Total	%
1	549	40.6	61	23.5	31	641	36.9
2	298	22.1	39	14.9	23	360	20.7
3	150	11.1	20	7.7	8	178	10.2
4	83	6.1	23	8.8	8	114	6.5
5	47	3.5	14	5.4	5	66	3.8
6	40	2.9	13	5.0	2	55	3.2
7	37	2.7	6	2.3	3	46	2.6
8	19	1.4	7	2.7	6	32	1.8
9	14	1.0	6	2.3	2	22	1.3
10	7	.5	3	1.1	9	19	1.1
11	6	.4	3	1.1	4	13	.7
12	6	.4	2	.8	2	10	.6
13	9	.7	1	.4	4	14	.8
14	3	.2	6	2.3	1	10	.6
15	5	.4	4	1.5		9	.5
16 to 20	24	1.8	14	5.4	5	43	2.5
21 to 25	11	.8	6	2.3	3	20	1.1
26 to 30	4	.3	4	1.5	4	12	.7
31 to 35	4	.3	4	1.1		7	.4
36 to 40	6	.4	2	.8		8	.5
41 to 50	2	.2	3	1.1		5	.3
51 to 75	9	.7	4	1.5	1	14	.8
76 to 100	7	.5	5	1.9	1	13	.7
Over 100	14	1.0	12	4.6	4	30	1.7
No Data	7		4		14	25	1.7
Total	1361		265		140	1766	

No. of Fires, 1897-1925, inclusive

No. of Sprinklers Operating	Wet	%	Dry	%	No Data	Total	%
1	9639	37.7	1056	19.7	49	10744	33.6
2	4778	17.8	746	13.9	27	5551	17.4
3	2698	10.1	459	8.6	12	3169	9.9
4	1890	7.0	397	7.3	12	2299	7.2
5	1170	4.3	254	4.7	7	1431	4.5
6	943	3.5	245	4.5	5	1193	3.7
7	657	2.4	170	3.1	4	831	2.6
8	612	2.3	156	2.9	6	774	2.4
9	388	1.4	119	2.2	3	510	1.6
10	352	1.2	101	1.9	10	463	1.4
11	257	1.0	99	1.8	4	360	1.1
12	306	1.1	109	2.0	3	418	1.3
13	173	.7	81	1.5	5	259	.8
14	196	.7	83	1.5	2	281	.9
15	157	.6	87	1.6	1	245	.8
16 to 20	568	2.0	243	4.5	8	819	2.5
21 to 25	329	1.1	179	3.3	3	511	1.6
26 to 30	240	.9	115	2.1	5	360	1.1
31 to 35	153	.6	72	1.3	2	227	.7
36 to 40	134	.5	73	1.3		207	.6
41 to 50	161	.6	102	1.9	1	264	.8
51 to 75	230	.9	135	2.5	2	367	1.1
76 to 100	97	.4	70	1.3	3	170	.5
Over 100	348	1.2	250	4.6	4	602	1.9
No Data			31		402	469	
Total	26512		5432		580	32524	
Water shut off sprinklers						270	
Total						32794	

Table No. 2—Number of Sprinklers Operating.

No of Sprinklers Operating	No. of Fires, 1897-1925, inclusive						
	Wet	%	Dry	%	No Data	Total	%
1	9639	36.4	1056	19.6	49	10744	33.5
2 or less....	14417	54.3	1802	33.4	76	16295	50.8
3 or less....	17115	64.6	2261	41.9	88	19464	60.7
4 or less....	19005	71.8	2658	49.2	100	21763	67.8
5 or less....	20175	76.2	2912	53.9	107	23194	72.3
6 or less....	21118	79.7	3157	58.5	112	24387	76.0
7 or less....	21775	82.2	3327	61.8	116	25218	78.6
8 or less....	22387	84.5	3483	64.6	122	25992	81.0
9 or less....	22775	86.0	3602	66.7	125	26502	82.7
10 or less....	23127	87.2	3703	68.6	135	26965	84.0
11 or less....	23384	88.3	3802	70.5	139	27325	85.2
12 or less....	23690	89.5	3911	72.4	142	27743	86.5
13 or less....	23863	90.2	3992	73.9	147	28002	87.4
14 or less....	24059	90.8	4075	75.5	149	28283	88.3
15 or less....	24216	91.4	4162	77.1	150	28528	88.9
20 or less....	24784	93.4	4405	81.6	158	29347	91.5
25 or less....	25113	94.8	4584	84.9	161	29858	93.2
30 or less....	25353	95.6	4699	87.0	166	30218	94.3
35 or less....	25506	96.3	4771	88.5	168	30445	95.0
40 or less....	25640	96.7	4844	89.5	168	30652	95.6
50 or less....	25801	97.4	4946	91.5	169	30916	96.4
75 or less....	26031	98.2	5081	94.0	171	31283	97.6
100 or less....	26128	98.7	5151	95.4	174	31453	98.1
Over 100	348	1.3	250	4.6	4	602	1.9
No Data	36		31		402	469	
	26512		5432		580	32524	
Water shut off sprinklers						270	
Total						32794	

Table No. 3—Effect of Sprinklers.

	1924-25		1897-1925, incl.	
	No. of Fires	%	No. of Fires	%
Practically or entirely extinguished.....	1270	71.9	21843	66.7
Held fire in check.....	431	24.4	9545	29.1
Total Satisfactory	1701	96.3	31388	95.8
Unsatisfactory	65	3.7	1390	4.2
Total	1766		32778	

Table No. 4

Effect of Sprinklers by Class of Occupancy.

	Extinguished Fire		Held Fire in Check		Total Satisfactory		Unsatisfactory		Total No. of Fires
	No.	%	No.	%	No.	%	No.	%	
Agricultural Implements	53	57.0	35	37.6	88	94.6	5	5.4	93
Apartments	30	90.9	3	9.1	33	100.0	..	..	33
Artificial Leather	14	38.9	20	55.6	34	94.5	2	5.5	36
Automobile and Bicycle Factories	154	59.7	90	34.9	244	94.6	14	5.4	258
Awning Factories	6	66.7	3	33.3	9	100.0	..	..	9
Bag Factories	17	51.5	15	45.5	32	97.0	1	3.0	33
Bakeries	84	74.4	25	22.1	109	96.5	4	3.5	113
Basket Factories	7	87.5	1	12.5	8	100.0	..	..	8
Bolt, Nut and Screw Works	19	65.5	10	34.5	29	100.0	..	..	29
Boot and Shoe Shops	663	73.5	207	23.0	870	96.5	32	3.5	902
Bottle Caps and Seals	18	50.0	18	50.0	36	100.0	..	..	36
Bottling Works	5	83.4	..	....	5	83.4	1	16.6	6
Braid Mills	21	75.0	6	21.4	27	96.4	1	3.6	28
Brass Works	48	68.6	20	28.6	68	97.2	2	2.8	70
Breweries	5	83.4	1	16.6	6	100.0	..	..	6
Broom Factories	12	63.2	5	26.3	17	89.5	2	10.5	19
Brush Factories	21	72.4	8	27.6	29	100.0	..	..	29
Button Factories	55	82.1	10	15.0	65	97.1	2	2.9	67
Candle Factories	6	46.1	7	53.9	13	100.0	..	..	13
Candy Factories	134	71.7	47	25.2	181	96.9	6	3.1	187
Canning Factories	12	57.2	6	28.6	18	85.8	3	14.2	21
Car Houses	30	44.1	31	45.6	61	89.7	7	10.3	68
Car Works	80	62.0	44	34.1	124	96.1	5	3.9	129
Carpet Mills	170	61.8	95	34.8	265	96.6	10	3.4	275
Carriage and Automobile Body Factories	113	60.2	57	30.3	170	90.5	18	9.5	188
Celluloid (Pyroxylin Plastic)	158	67.0	52	21.9	210	88.9	26	11.1	236
Cement and Plaster Works	6	66.7	2	22.2	8	88.9	1	11.1	9
Cereal Mills	35	64.8	12	22.2	47	87.0	7	13.0	54
Chemical and White Lead	115	60.5	59	31.0	174	91.5	16	8.5	190
Clothing Factories	1293	84.8	222	14.5	1515	99.3	11	.7	1526
Clubs	10	88.5	2	10.6	12	99.1	1	.9	13
Coffee and Spice Mills	56	66.6	24	28.6	80	95.2	4	4.8	84
Coffin Factories	57	73.1	19	24.4	76	97.5	2	2.5	78
Cold Storage Plants	6	54.6	5	45.4	11	100.0	..	..	11
Cooperage Plants	47	55.4	27	31.8	74	87.2	11	12.8	85
Cordage Works	222	65.4	106	31.2	328	96.6	12	3.4	340
Cork Factories	19	48.7	16	41.0	35	89.7	4	10.3	39
Corset Factories	11	73.4	3	20.0	14	93.4	1	6.6	15
Cotton Ginnery	8	61.6	5	38.4	13	100.0	..	..	13
Cotton Mills	4206	62.2	2473	36.8	6679	99.0	78	1.0	6757
Cotton Seed Oil Mills	39	47.6	29	35.4	68	83.0	14	17.0	82
Cotton Warehouses	149	46.0	149	46.0	298	92.0	26	8.0	324
Cutlery and Tools	25	64.0	12	30.8	37	94.8	2	5.2	39
Department Stores	444	78.5	106	18.7	550	97.2	16	2.8	566
Distilleries	7	63.7	3	27.2	10	90.9	1	9.1	11
Doll Factories	38	61.3	24	38.7	62	100.0	..	..	62
Drug Houses	183	80.0	42	18.3	225	98.3	4	1.7	229
Dry Cleaning Establishments	7	63.6	4	36.4	11	100.0	..	..	11
Dry Goods Stores	208	84.1	38	15.4	246	99.5	1	.5	247
Dyeing, Bleaching and Finishing	164	54.2	125	41.3	289	95.5	14	4.5	303
Electrical Appliances	233	68.4	100	29.3	333	97.7	8	2.3	341
Electric Light and Power Plants	4	30.8	7	53.9	11	84.7	2	15.3	13
Elevators, Grain	28	37.3	28	37.3	56	74.6	19	25.4	75
Excelsior Factories	25	75.7	5	15.1	30	90.8	3	9.2	33
Fertilizer Plants	28	65.2	11	25.6	39	90.8	4	9.2	43
Flax and Linen Mills	31	49.2	32	50.8	63	100.0	..	..	63
Flour and Grist Mills	63	54.8	36	31.3	99	86.1	16	13.9	115
Forge and Smithy	16	69.6	6	26.1	22	95.7	1	4.3	23

Table No. 4 — Continued.

	Extinguished Fire		Held Fire in Check		Total Satisfactory		Unsatisfactory		Total No. of Fires
	No.	%	No.	%	No.	%	No.	%	
Foundries	164	57.8	107	37.7	271	95.5	13	4.5	284
Fur Works	49	90.8	4	7.4	53	98.2	1	1.8	54
Furniture Factories	583	65.0	243	27.2	826	92.2	70	7.8	896
Furniture Stores	53	76.7	12	17.4	65	94.1	4	5.9	69
Garages	195	70.0	78	28.0	273	98.0	6	2.0	279
Garbage Reduction Plants	3	60.0	1	20.0	4	80.0	1	20.0	5
Gas Plants	2	66.7	1	33.3	3	100.0	..	..	3
General Stores	16	80.0	4	20.0	20	100.0	..	..	20
Glass Works	52	51.5	38	37.6	90	89.1	11	10.9	101
Glove Factories	10	71.4	3	21.4	13	92.8	1	7.2	14
Glue Factories	9	59.6	4	26.6	13	86.2	2	13.8	15
Groceries	104	81.3	18	14.1	122	95.4	6	4.6	128
Hardware Stores	69	85.2	11	13.6	80	98.8	1	1.2	81
Harness and Fancy Leather	122	84.0	22	15.2	144	99.2	1	.8	145
Hat Factories	184	74.6	52	21.1	236	95.7	11	4.3	247
Hatters' Fur Works	13	50.0	9	34.5	22	84.5	4	15.5	26
Hotels	35	77.8	9	20.0	44	97.8	1	2.2	45
Ice Plants	2	66.7	1	33.3	3	100.0	..	..	3
Incandescent Lamp Works	20	62.5	12	37.5	32	100.0	..	..	32
Institutions	10	71.4	3	21.4	13	92.8	1	7.2	14
Insulated Wire Factories	33	63.5	19	36.5	52	100.0	..	..	52
Jewelry Factories	144	86.8	16	9.7	160	96.5	6	3.5	166
Junk Shops	21	77.8	5	18.5	26	96.3	1	3.7	27
Knitting Mills, Cop Yarn	54	65.9	21	25.6	75	91.5	7	8.5	82
Knitting Mills, Full Process	501	65.1	243	31.6	744	96.7	25	3.3	769
Laundries	65	72.2	22	24.4	87	96.6	3	3.4	90
Lead Pencil Factories	16	66.7	7	29.2	23	95.9	1	4.1	24
Linseed Oil Works	18	53.0	12	35.3	30	88.3	4	11.7	34
Machine Works	310	66.7	130	28.1	440	94.8	24	5.2	464
Mail Order Houses	29	93.6	2	6.4	31	100.0	..	..	31
Match Factories	53	74.6	14	19.7	67	94.3	4	5.7	71
Mattress Factories	389	69.7	160	28.7	549	98.4	9	1.6	558
Mercantile (Miscellaneous)	660	80.4	140	17.0	800	97.4	21	2.6	821
Metal Reduction Works	10	66.7	5	33.3	15	100.0	..	..	15
Metal Workers†	842	65.2	397	30.7	1239	95.9	53	4.1	1292
Miscellaneous	503	73.0	153	22.2	656	95.2	33	4.8	689
Morocco Leather Shops	39	54.2	24	33.3	63	87.5	9	12.5	72
Motion Pictures	67	81.7	14	17.1	81	98.8	1	1.2	82
Multiple Occupancy	..	..	1	100.0	1	100.0	..	..	1
Munition Factories	22	41.5	22	41.5	44	83.0	9	17.0	53
Musical Instrument Factories	124	67.6	54	29.3	178	96.9	6	3.1	184
Office Buildings	40	89.0	5	11.0	45	100.0	..	..	45
Oilcloth and Linoleum Works	40	32.0	65	52.0	105	84.0	20	16.0	125
Oil Clothing Factories	12	70.6	5	29.4	17	100.0	..	..	17
Oil Refineries									
Animal	2	40.0	3	60.0	5	100.0	..	..	5
Mineral	6	85.7	1	14.3	7	100.0	..	..	7
Vegetable	3	33.3	5	55.6	8	88.9	1	11.1	9
Packing House and Slaughter	148	70.4	54	25.7	202	96.1	8	3.9	210
Paint and Varnish Works	196	67.2	85	29.1	281	96.3	11	3.7	292
Paper Box and Papeterie	201	75.9	58	21.9	259	97.8	6	2.2	265
Paper Mills	407	49.8	342	41.9	749	91.7	68	8.3	817
Patent Leather Works	11	37.9	14	48.4	25	86.3	4	13.7	29
Phonograph Works	20	74.0	6	22.2	26	96.2	1	3.8	27
Photograph Works	32	76.2	9	21.4	41	97.6	1	2.4	42
Picture Frame Factories	44	64.7	18	26.5	62	91.2	6	8.8	68
Piers and Wharves	6	37.5	8	50.0	14	87.5	2	12.5	16
Plumbers' Supplies	27	75.0	9	25.0	36	100.0	..	..	36
Potteries	46	63.9	21	29.2	67	93.1	5	6.9	72
Printing and Lithographing	708	81.1	147	16.8	855	97.9	18	2.1	873

Table No. 4 — Concluded.

	Extinguished Fire		Held Fire in Check		Total Satisfactory		Unsatisfactory		Total No. of Fires
	No.	%	No.	%	No.	%	No.	%	
Public Buildings	..	..	1	100.0	1	100.0	..	..	1
Pulp Mills	32	34.8	39	42.4	71	77.2	21	22.8	92
Railroad Property	1	25.0	2	50.0	3	75.0	1	25.0	4
Restaurants	52	76.5	15	22.1	67	98.6	1	1.4	68
Rice Mills	2	50.0	1	25.0	3	75.0	1	25.0	4
Rolling, Wire and Tube Works	31	58.5	20	37.8	51	96.3	2	3.7	53
Roofing Works	29	40.8	35	49.4	64	90.2	7	9.8	71
Rubber Cloth Factories	26	57.7	18	40.0	44	97.7	1	2.3	45
Rubber Reclaiming Works	7	35.0	9	45.0	16	80.0	4	20.0	20
Rubber Works	151	50.1	131	43.5	282	93.6	19	6.4	301
Saw and Planing Mills	86	43.2	65	32.7	151	75.9	48	24.1	199
Schools	10	76.9	3	23.1	13	100.0	..	..	13
Ships and Shipbuilding	5	45.5	6	54.5	11	100.0	..	..	11
Shirt Factories	56	87.5	8	12.5	64	100.0	..	..	64
Shoddy Mills	213	65.4	92	28.2	305	93.6	21	6.4	326
Shoe Stores	44	88.0	6	12.0	50	100.0	..	..	50
Silk Mills	92	76.0	25	20.6	117	96.6	4	3.4	121
Skin Mills	7	87.5	1	12.5	8	100.0	..	..	8
Soap Manufacturing	35	77.8	9	20.0	44	97.8	1	2.2	45
Stamping and Sheet Metal Works	80	62.5	38	29.7	118	92.2	10	7.8	128
Starch and Glucose Works	12	50.0	4	16.7	16	66.7	8	33.3	24
Sugar Refineries	26	57.8	17	37.8	43	95.6	2	4.4	45
Tanneries	43	50.0	35	40.7	78	90.7	8	9.3	86
Tenant Manufacturing	721	74.7	196	20.3	917	95.0	48	5.0	965
Theatres	54	76.0	14	19.7	68	95.7	3	4.3	71
Tobacco Factories	59	72.8	19	23.5	78	96.3	3	3.7	81
Trunk Factories	23	69.7	8	24.2	31	93.9	2	6.1	33
Wall Paper Factories	19	68.0	5	17.9	24	85.9	4	14.1	28
Warehouses	385	70.2	135	24.6	520	94.8	28	5.2	548
Waste and Batting Mills	273	60.4	162	35.8	435	96.2	18	3.8	453
Waste Paper and Rag Shops	81	62.8	45	34.9	126	97.7	3	2.3	129
Weaving Mills	125	66.9	57	30.4	182	97.3	5	2.7	187
Window Shade Factories	12	85.7	..	....	12	85.7	2	14.3	14
Woodworkers, Class A*	160	55.0	90	31.0	250	86.0	41	14.0	291
Woodworkers, Class B*	153	51.9	113	38.3	266	90.2	29	9.8	295
Woodworkers, Class C*	134	60.9	76	34.5	210	95.4	10	4.6	220
Woodworkers, Class D*	95	57.3	52	31.4	147	88.7	19	11.3	166
Woodworkers, Class E*	173	65.0	82	30.8	255	95.8	11	4.2	266
Woodworkers, Class F*	39	61.9	20	31.7	59	93.6	4	6.4	63
Woolen Mills	945	69.8	344	25.2	1289	95.0	64	5.0	1353
Wool Storehouses	28	70.0	10	25.0	38	95.0	2	5.0	40
Worsted Mills	62	53.0	41	35.1	103	88.1	14	11.9	117
Total Sprinkler Fires	21,843		9,545		31,388		1,390		32,778

*The Woodworkers are classed as follows :

Class A. Interior Woodwork, builders' supplies (including veneer works).

Class B. Box Factories (including cigar boxes).

Class C. Miscellaneous Woodworkers. Steam power tenant Woodworkers. Woodworkers where there is a lack of detailed information as to class.

Class D. Sash, Door and Blind Factories.

Class E. Hard Wood Turning (wheels, pipes, novelties, bobbins, spools, etc., last and wood heel factories).

Class F. Pails and Woodenware (Plates, wooden bowls, tubs, etc.)

†Other Metal Working Occupancies are included under Agricultural Implements; Automobile and Bicycle Factories; Bolt, Nut and Screw Works; Electrical Appliances; Forge and Smithy; Foundries; Machine Works; Rolling, Wire and Tube Works; and Stamping and Sheet Metal Works.

Table No. 5

Classification of Unsatisfactory Sprinkler Fires by Occupancy.

	Water shut off sprinklers.	Generally defective equipment and unsprinklered portions.	Defective water supply or supplies.	Sprinkler system crippled due to freezing.	Slow operation of dry system or defective dry valve.	Slow or defective operation of high test heads.	Faulty building construction, concealed spaces, vertical openings.	Obstruction to distribution.	Hazard of occupancy too severe for average sprinkler equipment.	Sprinkler system crippled by explosion.	Exposure or conflagration.	Plugged Heads.	Miscellaneous.	Total.
Agricultural Implements	3	1	..	..	..	..	..	..	1	..	..	..	..	5
Artificial Leather	..	..	..	..	..	..	1	..	..	1	..	..	..	2
Automobile and Bicycle	7	1	1	..	..	..	..	4	..	..	1	..	..	14
Bag Factories	..	..	..	..	..	1	..	..	..	..	..	..	..	1
Bakeries	2	1	..	..	..	..	..	..	..	..	..	..	1	4
Boot and Shoe Shops	12	6	2	..	..	1	..	1	..	2	5	..	3	32
Bottling Works	..	1	..	..	..	..	..	..	..	..	..	..	..	1
Braid Mill	..	1	..	..	..	..	..	..	..	..	..	..	..	1
Brass Works	..	1	..	..	..	..	..	..	..	..	..	..	1	2
Broom Factories	2	..	..	..	..	..	..	..	..	..	..	..	..	2
Button Factories	..	..	..	2	..	..	..	..	..	..	..	..	..	2
Candy Factories	2	..	..	..	1	..	2	..	..	..	..	..	1	6
Canning Works	1	..	..	..	1	..	..	..	..	..	1	..	..	3
Car Houses	2	2	1	..	1	..	..	1	..	..	..	..	..	7
Car Works	2	1	..	..	..	..	1	1	..	..	..	..	..	5
Carpet Mills	4	2	3	..	..	..	..	1	..	..	..	..	..	10
Carriage Factories	4	4	3	..	2	..	..	1	1	..	2	1	..	18
Celluloid (Pyroxylin)	1	1	3	1	1	..	2	2	8	5	2	..	..	26
Cement and Plaster Works	..	..	..	..	1	..	..	..	..	..	..	..	..	1
Cereal Mills	..	2	1	..	..	..	..	1	..	3	..	..	..	7
Chemical and White Lead	2	4	..	..	..	..	..	..	4	5	..	..	1	16
Clothing Factories	3	..	2	1	..	..	2	2	..	..	1	..	..	11
Clubs	..	..	..	..	..	..	1	..	..	..	..	..	..	1
Coffee and Spice Mills	2	..	..	..	..	..	..	1	..	1	..	..	..	4
Coffin Factories	1	..	..	1	..	..	..	..	..	..	..	..	..	2
Cooperage Plants	1	4	..	..	..	1	..	4	..	..	1	..	..	11
Cordage Works	3	4	1	1	..	..	..	2	..	..	..	..	1	12
Cork Factories	1	..	1	..	..	..	..	..	..	1	..	..	1	4
Corset Factories	..	..	..	..	..	..	..	..	..	..	1	..	..	1
Cotton Mills	27	21	6	2	..	1	5	1	3	..	..	2	10	78
Cotton Warehouses	14	1	2	..	..	..	1	4	2	..	..	..	2	26
Cotton Seed Oil Mills	3	5	2	..	..	..	..	..	1	..	..	..	3	14
Cutlery and Hardware	1	1	..	..	..	..	..	..	..	..	..	..	..	2
Department Stores	6	4	..	..	1	..	1	1	..	..	2	..	1	16
Distilleries	..	..	..	..	..	..	..	..	..	..	1	..	..	1
Drug Houses	..	..	..	..	..	..	..	..	..	..	3	..	1	4
Dry Goods Stores	..	..	..	..	..	..	..	1	..	..	..	..	..	1
Dyeing, Bleaching and Finishing	5	3	1	..	1	1	..	1	..	..	1	..	1	14
Electrical Appliances	2	..	2	..	..	..	1	1	..	..	..	..	2	8
Electric Light and Power Plants	..	1	..	..	..	..	..	1	..	..	..	..	..	2
Elevators, Grain	..	4	5	..	2	..	2	1	1	1	2	..	1	19
Excelsior Factories	..	..	2	..	..	..	..	..	1	..	..	..	..	3
Fertilizer Plants	2	1	..	..	1	..	..	..	..	..	..	..	..	4

Table No. 5 — Continued.

	Water shut off sprinklers.	Generally defective equipment and unsprinklered portions.	Defective water supply or supplies.	Sprinkler system crippled due to freezing.	Slow operation of dry system or defective dry valve.	Slow or defective operation of high test heads.	Faulty building construction, concealed spaces, vertical openings.	Obstruction to distribution.	Hazard of occupancy too severe for average sprinkler equipment.	Sprinkler system crippled by explosion.	Exposure or conflagration.	Plugged Heads.	Miscellaneous.	Total.
Flour and Grist Mills	3	2	1	..	1	..	1	1	1	3	2	..	1	16
Forge and Smithy	..	..	..	..	..	..	..	1	..	..	..	..	..	1
Foundries	10	1	1	..	..	..	..	..	..	1	..	..	..	13
Fur Works	..	..	..	..	..	..	1	..	..	..	..	..	..	1
Furniture Factories	23	15	2	3	..	..	3	9	8	..	4	2	1	70
Furniture Stores	4	..	..	..	..	..	..	..	..	..	..	..	..	4
Garages	4	..	..	..	..	..	..	2	..	..	..	..	..	6
Garbage Reduction Plants	1	..	..	..	..	..	..	..	..	..	..	..	..	1
Glass Works	2	1	2	1	..	..	1	1	..	..	..	..	3	11
Glove Factories	1	..	..	..	..	..	..	..	..	..	..	..	..	1
Glue Factories	1	..	..	..	..	..	..	..	1	..	..	..	..	2
Groceries	4	..	1	..	1	..	..	..	..	..	..	..	..	6
Hardware Stores	1	..	..	..	..	..	..	..	..	..	..	..	..	1
Harness and Fancy Leather	..	..	..	..	..	..	..	..	..	..	..	..	1	1
Hat Factory	4	3	1	..	1	..	..	1	..	..	..	..	1	11
Hatters' Fur Mfg	2	..	1	..	..	..	1	..	..	..	..	..	..	4
Hotels	..	..	1	..	..	..	..	..	..	..	..	..	..	1
Institutions	..	..	..	..	1	..	..	..	..	..	..	..	..	1
Jewelry Shops	2	1	..	2	..	..	1	..	..	..	..	..	..	6
Junk Shops	1	..	..	..	..	..	..	..	..	..	..	..	..	1
Knitting, Cop Yarn	1	1	3	..	..	..	..	1	..	1	..	..	..	7
Knitting, Full Process	7	9	5	1	1	..	1	..	..	1	..	..	..	25
Laundries	2	..	..	..	..	..	..	1	..	..	..	..	..	3
Lead Pencil Works	..	..	..	..	..	..	..	..	..	1	..	..	..	1
Linseed Oil Works	1	..	..	..	..	..	..	..	..	2	..	..	1	4
Machine Shops	15	5	1	1	..	1	..	..	..	1	..	..	..	24
Match Factories	2	..	..	..	..	..	..	..	1	..	..	..	1	4
Mattress Factories	4	2	..	1	..	..	..	2	..	..	..	..	..	9
Mercantile (Miscel.)	6	4	1	2	..	..	3	..	..	..	4	..	1	21
Metal Workers†	17	13	2	..	..	1	3	2	4	3	2	2	4	53
Miscellaneous	7	6	2	1	1	1	2	1	5	1	2	..	4	33
Morocco Leather Shops	3	3	..	..	1	..	1	..	..	..	..	..	1	9
Motion Pictures	1	..	..	..	..	..	..	..	..	..	..	..	..	1
Munitions Factories	2	..	..	1	..	..	..	..	4	1	..	..	1	9
Musical Instrument Factories	1	3	..	..	..	..	1	..	..	..	1	..	..	6
Oilcloth and Linoleum Works	..	5	..	..	..	..	1	3	11	..	..	..	..	20
Oil Refinery (Vegetable)	..	..	1	..	..	..	..	..	..	..	..	..	..	1
Packing House and Slaughter	1	2	1	..	2	..	..	..	1	..	..	..	1	8
Paint and Varnish Works	1	2	4	..	..	..	3	..	1	..	..	..	..	11
Paper Box and Papeterie	4	1	..	..	1	..	..	..	..	..	..	..	..	6
Paper Mills	14	20	6	3	1	3	2	..	4	2	2	1	10	68
Patent Leather Works	1	..	1	1	..	..	1	..	..	..	..	..	..	4
Phonograph Works	1	..	..	..	..	..	..	..	..	..	..	..	..	1
Photograph Works	1	..	..	..	..	..	..	..	..	..	..	..	..	1
Picture Frame Factories	1	2	1	1	..	..	..	1	..	..	..	..	..	6

Table No. 5—Concluded.

	Water shut off sprinklers.	Generally defective equipment and unsprinklered portions.	Defective water supply or supplies.	Sprinkler system crippled due to freezing.	Slow operation of dry system or defective dry valve.	Slow or defective operation of high test heads.	Faulty building construction, concealed spaces, vertical openings.	Obstruction to Distribution.	Hazard of occupancy too severe for average sprinkler equipment.	Sprinkler system crippled by explosion.	Exposure or conflagration.	Plugged Heads.	Miscellaneous.	Total.
Piers and Wharves	..	1	1	..	..	..	..	..	..	..	..	..	..	2
Potteries	1	1	1	1	..	..	..	..	..	1	..	..	..	5
Printing and Lithographing	7	4	1	..	..	..	1	1	..	..	3	..	1	18
Pulp Mills	8	3	4	..	1	1	1	..	1	1	..	..	1	21
Railroad Property	1	..	..	..	..	..	..	..	..	..	..	..	..	1
Restaurants	..	..	..	..	..	..	1	..	..	..	..	..	..	1
Rice Mills	..	..	1	..	..	..	..	..	..	..	..	..	..	1
Rolling, Wire and Tube Works	..	..	..	..	..	1	1	..	..	..	..	..	..	2
Roofing Works	2	2	..	1	..	..	1	..	..	1	..	..	..	7
Rubber Cloth Mill	..	..	..	..	..	..	..	..	..	..	..	..	1	1
Rubber Reclaiming Works	1	..	..	..	..	..	1	..	1	1	..	..	..	4
Rubber Works	7	..	..	1	..	..	..	1	5	3	..	1	1	19
Saw and Planing Mills	11	9	2	..	4	1	6	2	4	..	5	1	3	48
Shoddy Mills	6	3	6	..	1	3	..	1	..	..	..	..	1	21
Silk Mills	2	1	..	..	..	..	..	..	..	1	..	..	..	4
Soap Manufacturing	..	1	..	..	..	..	..	..	..	..	..	..	..	1
Stamping and Sheet Metal Works	1	2	1	..	1	..	2	..	..	..	2	..	1	10
Starch and Glucose Mills	..	..	..	..	..	..	..	..	1	7	..	..	..	8
Sugar Refineries	1	..	..	..	..	..	..	..	..	1	..	..	..	2
Tanneries	1	1	..	3	..	..	..	..	1	..	1	..	1	8
Tenant Manufacturing	23	7	2	2	1	..	2	1	1	..	6	..	3	48
Theatres	2	1	..	..	..	..	..	..	..	..	..	..	..	3
Tobacco Factories	1	1	..	..	..	..	..	..	..	..	1	..	..	3
Trunk Factories	1	1	..	..	..	..	..	..	..	..	..	..	..	2
Wall Paper Factories	..	..	1	..	..	..	..	1	1	..	1	..	..	4
Warehouses	11	3	2	..	2	..	1	4	1	..	..	..	4	28
Waste and Batting Mills	5	4	3	1	..	1	..	1	2	..	..	..	1	18
Waste Paper and Rag Shops	2	1	..	..	..	..	..	..	..	..	..	..	..	3
Weaving Mills	1	1	2	1	..	..	..	..	..	..	..	..	..	5
Window Shade Factories	..	..	..	1	..	..	..	..	1	..	..	..	..	2
Woodworkers, Class A*	10	9	2	..	1	1	1	6	..	3	3	1	4	41
Woodworkers, Class B*	6	8	2	2	..	2	1	1	..	3	2	..	2	29
Woodworkers, Class C*	3	4	1	..	..	..	..	2	..	..	..	..	..	10
Woodworkers, Class D*	1	7	..	1	1	..	..	..	..	2	4	..	3	19
Woodworkers, Class E*	3	2	..	..	2	1	2	..	..	..	1	..	..	11
Woodworkers, Class F*	2	..	1	..	..	..	..	1	..	..	..	..	..	4
Woolen Mills	16	16	13	1	..	2	4	..	1	..	3	..	8	64
Wool Storehouses	..	2	..	..	..	..	..	..	..	..	..	..	..	2
Worsted Mills	3	3	2	1	..	..	1	..	..	..	..	..	4	14
Total Unsatisfactory Fires	410	276	124	42	37	24	71	80	83	60	72	11	100	1390

*See detailed classification of Woodworkers as given in note under Table No. 4.

†See note on Metal Workers under Table No. 4.

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